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The Odds Against Japan

By C. J. LAVAL

LITTLE hope exists that the Kremlin may agree to withdraw armed forces in The Far East for the creation of a demilitarized zone along the Manchurian border. This is the outstanding detail of the report presented in August to Foreign Minister Hachiro Arita by Mr. Tamekichi Ohta, the retiring Japanese Ambassador to Moscow, according to current news dispatches. At the same time other significant announcements follow on the heels of the Soviet Government's recent proclamation ordering that the number of recruits be increased by fifty per cent each year. The already formidable military strength of the Soviets in the Far East is to be further strengthened and increased.

"The Red Army in the Far East and the Russian Pacific Fleet," says M. Krutof, President of the Far Eastern Territory of the Soviets," are now ready to give an enemy a knock from which they will not soon recover." In the same statement to the Moscow correspondent of the *London Daily Telegraph* M. Krutof added that Russia is spending three billion roubles this year in the Far East alone and that a double track along the Amur River section of the Trans-Siberian Railway is being completed.

Continuously through recent times it has been made apparent in the news dispatches of correspondents, in official pronouncements, and in the speeches of Soviet leaders like Comrade Voroshilof, Commissar for Defense, that while sedulously fostering a militaristic spirit in the minds of the people, the Moscow Government has erected the most powerful fighting machine the world has ever known. The farm and the factory and the man in the street in Russia have all been put on a military basis. The Government employs every device of propaganda, and it controls all these —the press, radio, film and theater—to raise the spectre of armed aggression from Europe on the west, and from Japan in the Far East, and in this way public opinion has been "militarized" to a point that gives basis for the claim that Moscow could put six million equipped fighting men into the field within the space of weeks with an additional six millions held in reserve. According to authoritative reports military estimates of Russia in 1934 were a little short of 1,700 million roubles; in 1935 the total rose to 6,500 million roubles; for the year 1936 they are placed at 15,000 million roubles. Herein lies the cause of the anxiety in Tokyo.

With the utmost clarity, by word and deed, Moscow has announced to the world its intention. To press its ends it has adopted a variety of expedients and enticements, has shifted tactics as necessity compelled, and has disguised men and movements as needs required, but it has never deviated from the major underlying purpose, which is to replace the existing order of things in this world with the Soviet doctrine and with Soviet authority. This is proved continually by events in many widely separated lands. It furnishes the cause to-day for the fighting in Spain, which may set alight a new European conflagration. What this may mean for the world is to be seen in Russia and to a lesser degree in China, and in almost every land under the sun are to be found many in all walks of life, who in all sincerity or for their own interest, proclaim this proposed departure to be wholesome and good. These adherents have Moscow's cordial sympathy and every necessary material support.

Under force of circumstances the direction of the Communist movement has set definitely from west to east, and it appears that while events and conditions in countries of the Occident are by no means to be disregarded and left untended, the immediate thrust of the rulers of Russia is into the Far East to build on foundations laid in China, and Japan rises as the first major obstacle to be overcome. This is the single factor that determines what must be Japan's policy in the Far East and it supplies the reason for every move that Japan has made in China within recent years. It is paradoxical that the Muscovite challenge to an Occidental civilization has to be met by the Japanese, but the consequences of past events and present-day conditions seem to prove that this is true. And it will be tragically absurd when this challenge is met, as undoubtedly one day it must be met, if the great Anglo-Saxon powers are found ranged on the side of the Muscovite challenger and against the Japanese defender.

Japan's Task in China

For Japan the outlook is fraught with hazards. She cannot modify her policy in China, and she must attempt the seemingly hopeless task of overcoming present-day hostility and winning back to friendly alignment with the Occidental powers. It is the immediate difficult task for Japanese statesmanship to bring into play forces that will command support in the Occident and at the same time juggle events in China to the end that the rising tide of Communism in the country may be kept under control. China can do much to help or to hinder, but it appears to be as much to the advantage of the Chinese people as it is to the Japanese to hold Moscow at bay. Not a few Chinese patriots realize this and many who harbor in their hearts the bitterest rancor against Japan, admit, however grudgingly, that it is wiser to choose the lesser of two evils. Assuredly there exists this much "sincerity" among an important proportion of China's leaders, who with examples before their eyes and within their own bitter experience, can have no illusions about what a Communist control in China would mean while the procedure of co-operation with Japan at least is an untried expedient which possesses at any rate all the virtues that unqualified Japanese assurances may be worth.

The thrust of the Soviet into the Far East has been attended by remarkably favorable developments. Some fifteen years ago when the fortunes of China were first linked with Soviet Russia by Dr. Sun Yat-sen the probable effects of the introduction of communist thought and practice into China received some consideration. Following a series of conversations Dr. Sun Yat-sen and A. A. Joffe, the Soviet envoy of that time, issued a joint statement and in this the tenet was set forth piously that Chinese character and culture were such that the communist doctrine never could be implanted in the country. In answer to a question the great Chinese leader told the writer that the course he had taken had been thrust upon him. He had appealed to England, and to the United States, he explained, for aid he felt that China had to have from abroad, and his appeals had met denial. He had therefore accepted the help that Moscow proferred. He voiced the certain belief that communist thought never could take root in China and implied clearly that "China would know how to handle Russia if emergencies of this nature arose."

That marked the beginning of the great effort to absorb China into the regime of the Soviets, an effort that has met with checks, as in 1927 when the break came with the existing National Government at Nanking and through the almost incessant warfare of the past eight years, but the driving force behind the thrust into China has never been relaxed. Dr. Sun Yat-sen has passed on and since then his countrymen have been slaughtered by hundreds of thousands and while these things have happened the communist influence and power in China, slowly and inexorably, has spread over the land and ever gathered new strength. And a great unlettered, rural population—more than three hundred and fifty millions—in large proportion literally unclothed and starving, and bowed down under multiplied miseries of natural disasters, exploitation, taxation and militarism, is not to be blamed for turning in any direction for succor or for grasping any outstretched hand that holds the promise of filled rice bowls.

The Part the United States has Played

The reason for the advance and spread of Russian communism through China may be traced in a measure to actions of American statesmen and to American military intervention in Asia, the best help that the Bolshevist ideal could have received from any quarter, and to that extent the United States put itself into alliance with the Russian Soviets. The Washington Conference of 1921, although originally of British inspiration, was sponsored by Washington. The Conference and the Nine Power Treaty that grew out of it cleared the stage in China for the entry of communism, and while holding Japan in close restraint to a point that in the Japanese viewpoint imperilled the existence of their nation, assured to a disrupted China every right and privilege of untrammelled sovereignty, prohibiting interfence from any quarter. Moscow had no concern with these things and was left unrestrained by the agreements which were in perfect alignment with Russian aspirations in Asia. So far as anyone ever has been able to explain, the sole reason why Washington intervened in Siberia and sent an army into that country was to thwart Japanese ambitions there, which had as basis pledges given to Japan by the European allies, pledges that President Wilson successfully vetoed over dissent of his own military counsellors. Due to American action Japan at length was compelled to get out of Siberia, and the way was thus left open for Russian communism to penetrate unhindered through Siberia to the seaboard and thence into China. In the meantime Outer Mongolia very quietly had been divorced from China to become in the guise of an Outer Mongolian Republic a new concubine in the menage of the Russian Soviets. No protests about this were voiced at Geneva and the League sent no " commissions of inquiry," but on the contrary, admitting Moscow into the fold, gave passive endorsement that what had been done. Developments in Manchuria and creation of the new State of Manchoukuo came along later as further consequences when Japan at length decided she must act while she still could do so to save herself.

Japan's necessities grow more acute with each passing year. The area in square miles of these mountainous islands with a population of seventy millions in about ten thousand square miles less than that of the State of California with its population of five and a half millions, but the extent of Japan's arable land is only about one-sixth the area of California and less than half that of Iowa. The last resources of the available tillable land in Japan have been used and the population is increasing at the rate of nearly a million persons a year. Japan's effort to solve her population problem through industrialization are being balked by commercial restrictions on the free movement of commerce in raw materials and, especially in recent years, by higher and higher tariff walls in all parts of the world. No outlet for the nation's increasing population pressure has been found in Japan's dependencies—Korea, Formosa or in the South Sea islands, held under League mandate. Since the annexation of Korea in 1910 only about a half million Japanese have entered that country, whose population has more than doubled, while 700,000 Koreans have migrated into Japan, adding their weight to the population burden there. All doors overseas to the east and to the south are closed to Japanese entry by rigid immigration laws of Canada, the United States, Australia, New Zealand and South Africa. The effects on population pressure at home of Japanese colonization efforts in South America have been negligible. Immigration laws hold the Japanese in sharp check and high tariff walls everywhere bar out products of her industries whose expansion might absorb the population surplus and greatly increase Japan's purchases overseas of the whole list of raw materials that she lacks. These things can only mean that the success of moves to close the one channel of egress remaining to Japan, westward into Asia, dooms the Empire to extinction. Japan cannot submit to this.

Geneva's Judgment Still Valid

Japan through the years of her industrial expansion has become, after the United Kingdom and Canada, the best customer of the United States. She has righted as best she could her huge adverse balance of trade by sales in world markets of products made from raw materials largely purchased from the United States. In the same period of industrialization American armed intervention in Asia balked the entry of Japan and opened the way to Bolshevism in the former territory of China that is Siberia to-day. After bringing to an end at the Washington Conference the Anglo-Japanese Alliance, which through the years it operated put a check on Russian ambitions, the United States gave the cue to the League of Nations that brought down world condemnation on Japan and forced her to quit Geneva. No statute of limitations applies to the judgment that the League pronounced against Japan nearly four years ago. Russia now is a member of that august body and possesses a potent voice in its decisions.

All Europe still sees major trade advantages to be won and a solution of vexatious problems, like the debts to America, in a new war in the Pacific between the only two great powers that emerged with profits from the Great War. Such a conflict would be to the advantage of the Far Eastern trade of Britain, France, Belgium and Germany and would probably erect new security for the investments of these countries in the Far East. These investments, of Britain, for example, in China are estimated to total \$1,750,000,000—more than eleven times the American commercial stake in the country,—and the investments in China of the other European countries, regarding which official estimates are not available, run probably at least to another billion dollars. By force of that British conception, which through the years has come to be known as the *American* Open Door policy, European trade and investments in China have been well safe-guarded. They would be much enhanced in value if Japan and the United States went to war. Such a conflict, of course, would wipe out American Far Eastern trade and would destroy American investments of \$426,000,000 in Japan and the lesser American commercial stake of \$150,000,000 in China, but in paying this price to maintain the " sanctity of a treaty," although the treaty has been something of a liability and a disappointment to the United States, hopes would be brought to realization for five hundred million Chinese who haven't been able to do anything for themselves, but who in all conscience should be expected to show appreciation in a concrete way to the United States, if only some means might be devised to prevent Russia from gobbling up the spoils when the fighting ended and the war dead were buried.

Events both in Asia and in Europe are conspiring for the furtherance of Russian designs. Thus every move in China that Japanese leaders deem to be imperative is made to appear in a world overseas still under sway of the Stimson pronouncement and the action of the League as another step toward the " conquest of China " by Japan. The efforts of Japan to bring about mutually beneficial co-operation with China and to achieve an effective defensive alliance against a common menace are held up as acts of aggression.

A Victory of Doubtful Value

In one campaign after another Chiang Kai-shek, commanding the Nanking Government's military forces, has been fighting communist armies in China for the past eight years at a cost to the country of hundreds of thousands lives and the outlay of millions in treasure. Much has been made of the circumstance that communist armed forces last year moved out of regions they had long held under an established regime with their own, postal, banking, agrarian and other institutions. This was called the Soviet Socialist Republic of China and it was located in the provinces of Fukien and Kiangsi in southern China with its capital at Juikin, in Kiangsi. The communist influence is still seen in this territory, although the Red armies of some hundred thousand armed men and their followers have shifted into the far western provinces of China, remote from

the sea. This thousand-mile march across the country from south China to far Szechuen has been hailed as a great triumph for the forces of the Nanking Government. It appears to be capable of another interpretation, however, and a cynical view, which communist publications support, is that this great " victory " of the Nanking government forces originally was ordered by General Bluecher, Commander of the great Far Eastern military establishment of Soviet Russia in Siberia, who ten years ago was known in China as General Galens when he directed Chinese armies that marched from Canton to the Yangtze ultimately to form the existing Nanking Government.

All the circumstances surrounding this " retreat " of the Red armies in China seem to indicate the working out of a far-flung Russian plan of action. No Russian military enterprise in the Far East could be directed in its initial stages against south China where the Chinese Red armies formerly were stationed. Any Russian movement of this nature of necessity would be made in the north and after a Russian military success in the north no necessity to conquer the rest of China by arms would arise. The theater of conflict therefore must extend from Mongolia over the plains of Manchuria to the sea and a Red army stationed in South China could give no aid in any fighting in this region.

If these Chinese Red armies could be based in China's western fringe of provinces, however, and so brought nearer to contact with the established Red army in Outer Mongolia, which is under command of Russian officers, they might become highly competent in helping a Russian advance southward from Siberia into Manchuria and a successful thrust by these armies eastward into North China below the Great Wall from the province of Shansi, for example, would effect the complete envelopment of defending forces fighting in Manchuria. It is in this western fringe of China's provinces that the Red armies are marching to-day after their retreat from south China.

Along the northern border of Manchuria are the main forces of the Russian Soviet Far Eastern army, a force of more than a quarter of a million men completely equipped and mechanized to the point of eight horse-power of motors per man, according to the boast of Commissar of War Voroshilov. Steel and concrete fortifications and underground hangars sheltered from aerial attack stretch along the Manchurian border eastward to the sea and a secondary line of communication across Siberia to the coast has been provided far to the north of the Trans-Siberian railway. At Vladivostok is an unknown number of submarines that have been shipped in sections to be assembled at that port for action when needed and also at Vladivostok is an adequate force of airplanes and in particular many huge bombing planes groomed for a heralded " one-way flight " of seven hundred miles over the Sea of Japan to the great centers of population and industry in Japan. Through the workings of the Five Year plans great Far Eastern industrial establishments have been erected and immense quantities of supplies and munitions for the Far Eastern forces have been piled up in Siberia so that the Russian army in this region has been made autonomous and independent of that weak link in transport over the 4,000 miles of the railway, which was the factor that brought defeat to Russia at Japan's hands in 1905.

These things furnish the reasons why Japan is obliged to maintain in Manchoukuo her expensive military establishment, which, however, has a strength of less than 75,000 men, and it explains also why Japanese leaders feel that they must everlastingly keep their attention focussed on affairs in Manchuria and in North China, regardless of what opinion may be in the Occident. Under these conditions it seems unlikely that Japan can contemplate any major new commitments in China. All the indications of the situation point that, unless there is no other possible course, Japan's own self interest, her already over-strained internal economy, and her vast and costly preoccupations north of the Great Wall in Manchuria—that already have appalled her financiers and industrialists over what appears to them to be endless expenditure leading to future competition with home industries—all these factors must hold her back from moves in China proper toward what are called acts of aggression. These things give basis to repeated denials of Japanese statesmen that Japanese policy in China is based on aims of aggression.

Fears that Haunt Nippon

Assuredly the state of affairs in China holds possibilities that might send Japanese armed forces into swift action. It is understandable that Japanese leaders from time to time hear with dismay reports that important Left Wing groups of the Kuomintang party, opposing Moderates in control of the government, have entered a secret agreement with the Russian Soviets directed against Japan. This touches the Japanese where they are most acutely sensitive and is the kind of thing calculated to make Japanese military commanders reach for plans of campaign, putting in motion programs that are prepared and at hand. There is no turning back when this point is reached—no talk, no fan-fare, no warning; there is only swift precision of movement, as automatically carried out as results when a button is pushed and lights blaze. This lethal mechanism has a lever for starting only; after the thing is in motion the only way to stop it is to smash it. Any talk of secret treaties, therefore, at once stirs apprehensions in Japanese breasts, for they have sharply in mind the disclosure at the Washington Conference, which revealed for the first time—sixteen years after the event—that under secret treaty China had been in alliance with Russia in the Russo-Japanese war of 1905 and had escaped free from penalty when Japan had won that war.

The state of affairs, both in Asia and in Europe, falls with nicety into the designs of Soviet Russia. A none too distant day of conflict with Japan when the defeat of 1905 may be avenged and when Soviet ambition can take a long step forward is foreseen in Moscow as clearly as it is foreseen in Tokyo. The Stimson doctrine and the condemnation by the League of Nations, as well as the Shanghai warfare, have brought Japan into the disfavor of the outside world. When the conflict at Shanghai was in progress early in 1932 shoals of correspondents under the sound of the guns served to American newspaper readers hourly the record of events. It was a shocking chronicle that had immediate effects at Washington and in the mind of the American public, but the newspaper reports of that time necessarily passed over and ignored causes that brought about the events that were so dramatically described.

The course of events of the past three years leading up to the situation in China of the present day has only added fuel to the flame of Occidental ill-will toward Japan. Thus far Japan has been unable to do anything to counteract this growing hostility in the Occident and at the same time her leaders are convinced that if she desists from action in China she courts destruction, for a disorganized China cannot unaided resist the pressure of communism, which already is well-founded, armed and equipped over vast areas of the richest portions of China. Japan feels that she dare not stand passive in the face of an immediate menace, yet if she moves to prepare against it every development only fans the resentment against her that has been built up in Occidental countries, and particularly in the United States.

This is the problem that confronts Japanese statesmen to-day. Whatever may be the eventualities that grow out of the present situation assuredly it could work no ill for Japan, and it might be of inestimable advantage to that nation, if a formula might be devised to modify present thought currents in the lands of the Occident, to replace ill-will overseas with good-will, and to fan into renewed life the flame of old friendships and the real admiration for Japanese character and achievements, which were built up through the years of Japan's emergence as a world power and which are latent in the breasts of the people of the Occident. No ordinary methods and no moves through accustomed channels of diplomacy can serve this situation, which calls for all the genius and originality of true statesmanship. The course of play in the great game of international affairs undeniably has been going in favor of Russia and as the scope of action has broadened and grown more complex the Russian advantage has increased to a point that seems to be decisive. It is high time for check-mate, and it is Tokyo's move.

Electric Lamp Factory

A Chinese consortium that has already had experience in Japan in the manufacture of electric lamps has put up a factory at Cheribon (Netherlands Indies) for the making of such lamps. Japanese industry is said to be interested in the venture and the whole of the machinery is of Japanese make. The glass bulbs and various other parts will also be obtained from Japan. If the venture is a success, the semi-finished material that is at first to be made in Japan will gradually be made in Netherlands India.

Russia's Million Soldiers

By W. CHAPIN HUNTINGTON in the "New York Herald Tribune"

How big is the Red Army? Up to last year it had an official peace strength of 562,000 men. No one is quite certain whether this included the 100,000 special troops of the dread State Political Administration, or "G.P.U." which constitutes an autonomous body used to patrol borders, guard the railways and quell internal disorders.

In January, 1935, it was announced that the peace-time army had been increased to 940,000 and that the war budget had swollen to four times its size of two years ago and was then 6,500,000,000 roubles—equivalent at par to about G.$6,000,000,000. The ultimate war strength of the Red Army is estimated at not less than 8,000,000 men. It is now the largest army in the world.

Every year in the Soviet Union 1,200,000 men become twenty-one years of age and therefore liable for military service, which is universal and compulsory. Russia is now, as always, rich in man-power, and the authorities can afford to be selective. One-third of this contingent is therefore excluded from bearing arms, either owing to unsatisfactory physique or because of belonging to the disfranchised, politically "unreliable" classes—priests, peasants opposed to the government's collectivist policy, and the like. Such men serve as laborers on various defense projects. The Red Army is strictly a class organization and only "toilers" are allowed to have weapons. The Soviet authorities are taking no chances of an armed counter-revolution.

The Red Army consists of a standing army and a territorial army or militia. Since service in the standing army is, in most branches, for two years, if all the 800,000 annually accepted for training were enlisted in it, it would contain 1,600,000 men—a little more than the Czarist army just before the war. The Soviet Government has not been able to stand such a drain on its financial resources; hence, until this year, it has enrolled only 260,000 men yearly as regulars. The remainder served in the territorial army or outside the troop formations. However, now that the standing army has been increased about 70 per cent, its annual enrollment will presumably be increased correspondingly, to 450,000.

Unified Command

The armed forces of the U.S.S.R. are under the Commissar for War and Navy, Clement Voroshilov, a Russian of peasant origin who fought valiantly in the civil war against the Whites—a record which is an open sesame to the Red Army career. Voroshilov is fifty-four, personally agreeable and of a warm, impulsive nature. In the endless gossip as to who would succeed Stalin if—his name is often mentioned.

Voroshilov is assisted by three vice-commissars, and it is striking in a proletarian army that two of them—Tukhachevsky and Kamenev*—are of aristocratic birth and were trained in the Imperial Army. However, they too fought in the Red Army in the Civil War and are members in good standing of the Communist Party. Kamenev is a fine strategist and it is thanks to "specialists" of his type inherited from the old regime that the Red Army was victorious against the Whites and has reached its present stage of development.

There are few old "specialists" left to-day, however. The Soviet leaders always distrusted their loyalty to the Revolution and set commissars to watch them, just as was done in the French Revolution. In time many of these commissars learned the art of war and themselves became officers. The Red Army has now trained its own leaders, 68 per cent of whom are members of the all-powerful Communist Party. Of the army corps commanders, 100 per cent are Communists; of the division commanders, 90 per cent.

The old Czarist army was characterized by a strong caste system. Soldiers were forbidden by the regulations to smoke in public, to ride inside in street cars or to enter restaurants. They addressed their colonel as "Your High Well-born-ness" and a general as "Your Excellency." The Soviet leaders have endeavored to make the Red Army democratic while maintaining strict discipline. Its soldiers are called "Red-Army-ists"; and the hated word "officer" has been replaced by "commander"; and every officer from a general down is simply addressed as "Comrade Commander."

The big epaulettes of the past are gone and the only insignia of rank are small marks on the collar: for a full general four diamonds; for a colonel three oblongs; for a captain four squares. The junior (i.e., non-commissioned) ranks wear triangles. The salute off duty is optional. There are no orderlies. Women also may become commanders. A few years ago there were 149 women officers with troops and 340 women students in the military academies.

Worker Officers

Most of the officers are now drawn from the working and peasant classes. They study hard in the various military schools which have been established by the Soviet Government, but their training is criticized by foreign experts as being too stereotyped and rigid, a consequence of the limited general education with which they are admitted to the higher schools. Some I saw in the big hotels of Leningrad and Moscow were slovenly in appearance and table manners; others wore trim uniforms and carried themselves well.

The Red Army staff believes that the next war will be largely mechanical, and they have been working day and night to mechanize and motorize their army, to change from the conception of cavalry as the fastest formation to that of planes, automobiles and tanks. Vice-Commissar Tukhachevsky told the Soviet Congress last year that attention in 1935 would be mainly directed to administration and the art of mobility. He boasted that the Red Army of to-day had nothing in common with the immobile, awkward Czarist army of twenty years back.

Last year Voroshilov stated that the Red Army was the most mechanized in the world, having nearly eight horse-power of motors per man. It has been necessary to create new types of troop formations, he said, and to transform infantry and cavalry commanders into tank and aviation officers.

There is no doubt that the Red Army has one of the largest aviation forces in the world, with something like 4,000 planes in addition to 400 commercial planes owned by the government. Great advances have been made recently in bombing and pursuit planes. The personnel in the aviation forces is estimated at 35,000, of whom 6,000 are said to be flyers.

Like attention has been paid to tanks. Soviet officials claim that small tanks have multiplied twenty-five times in the last four years; heavy tanks, eight times. Foreign experts believe that the total number is now near 1,500. "We have now both quantitatively and qualitatively an excellent artillery," said Voroshilov last year, and European military men seem inclined to agree. From heavy artillery to machine-guns, which played such a dramatic rôle in the Revolution, there has been a great expansion in equipment.

Nevertheless, the old arms are not being neglected. It is recognized that the foot-soldier still remains the cornerstone of the military organization, and Budenny, the picturesque Soviet inspector of cavalry, said recently that cavalry was not dead yet, by a long shot. Certainly not in Russia, with its wide plains and tradition of horsemen. In this the Soviet military leaders agree with our own Chief of Staff that "after you reach the battlefield, the fastest element is the man on a horse."

Soviet Navy

The Soviet Navy does not amount to much, Russia is a land-locked empire whose main sea frontage is on the Arctic Ocean, and her chief reliance, now as always, is in her land forces. The

* Leo Kamenev was one of the group of sixteen that included also Gregory Zinovieff who were executed at Moscow on the morning of August 25, after conviction on charges of conspiracy against the State.

naval vessels are little more than a coast patrol, and the chief expansion recently has been in the construction of submarines. "We have no battleships or airplane carriers," Voroshilov told the Communist Congress last year. "We only want to defend our coasts, and we are convinced that the light naval forces and coast defenses we now have, and especially our naval aviation and submarines, can cripple an attacking enemy."

Russia is a huge country, two and a half times the size of the United States. How is it to be defended—and against whom ? Nature has provided a splendid defense on the North in the ice-bound Arctic coast, and on the South in high mountains and deserts. The danger zones are in the West where Poland, an ancient enemy, and Rumania lie across the border, and in the Far East where Japan dominates Manchuria and thus thrusts a wedge between Vladivostok and Eastern Siberia.

Both these zones are now fortified with steel and concrete defenses. In the Far East it has been necessary to create independent units of aviation, tanks and artillery and to maintain large garrisons because of the 4,000 mile distance from Moscow. As Aukhachevsky has frankly admitted, it took only 10 million ton-miles of railroad haul to throw a German infantry division from Berlin to Liege in the World War, but it would take 120 million ton-miles to transfer a Soviet division from Moscow to Vladivostok over the long Trans-Siberian Railroad. Even airplane fleets cannot be shifted back and forth, he explained ; the London-Melbourne flight, in which only six out of twenty planes reached Melbourne, taught that lesson.

The western frontier was pushed 400 miles nearer Moscow by the World War, which created an independent Poland. The new Baltic states of Lithuania, Latvia and Estonia would be on the flank of a Soviet army attacking Poland. Leningrad with its 3,000,000 population and expanding industries is only twenty miles from the Finnish frontier and is strategically threatened, as is the new industrial center at Dnieprostroy, where the famous dam built by Colonel Hugh Cooper is located.

As a whole, however, Russian industry is safer than in the past because, under the Five Year Plans, the heavy industries are being centered in the Ural Mountains, 800 miles inland and beyond the range of airplane bombardment.

Asiatic Russia

Asiatic Russia also is being industrialized, and a great metallurgical center has been established in the Kuznetsk coal basin, 1,000 miles east of the Urals. The Second Five Year Plan calls for another iron and steel machine building center in the Far East, capable eventually of forming a war-industrial basis for operation in that territory.

The two striking features of the Red Army which differentiate it from all others are, first, its political education and, second, its relation to the economic life of the nation. In no army of the world is so much devoted effort spent upon the political training of the men.

"The Red Army is not only a military school, but also a school of citizenship," says a recent article by a leading Communist. And War Commissar Voroshilov has said :

"The fighting ability of an army is directly proportional to the level of its political consciousness."

A special department of the War-Commissariat is that of Political Administration, which at the same time is under supervision of the Communist party. This organization extends through the army formations down to the regiments, which have bureaus of the Union of Communist Youth, cells of the Communist Party, company newspapers, Lenin corners, clubs, libraries and posters.

Specially trained "political leaders," subordinate to the regimental officers, guide the work, while the officers themselves conduct classes on such topics as national defense, the history of the Red Army, the Army and the Communist Party, the Soviet Union in a capitalist environment, the international organization of the toilers, the structure of the Soviet State, etc. Pretty heavy diet ! Small wonder that the men are often bored and would rather go for a walk ; but there is no escape. Nevertheless, half the Army to-day are members of the Union of Youth or of the Communist Party, and enough "activists" are developed to prevent disaffection and to nip mutiny in the bud. There has been no Bonapartism in the Red Army thus far.

Some features of the propaganda are most effective. For example, recruits at first receive no arms. Then, one day the company is assembled and the regimental commander appears and addresses them. "It is a great honor to bear arms in the land of the Soviets," he says. "You are worthy of this honor." Whereupon, to the accompaniment of band music, each man is solemnly called up and handed a rifle.

A tremendous effort is made to integrate the army with the population and with economic processes. A German military critic has called the Red Army a "maid of all work." The Red-Army-ist, the "citizen-fighter," must be the model for all other citizens. The Army helps in sowing, harvesting, tax collecting, pushing the sale of government bonds, fighting religion, forcing the collectivization of agriculture. It has flying detachments which are sent out into the country with propaganda pamphlets, printing presses, musical instruments and moving pictures.

All this under military discipline and at no cost to the government ! Conversely, factories assume the patronage of regiments quartered in their neighborhoods and invite the soldiers to their meetings and entertainments, thus interesting them in the processes of production.

A striking book by three Swedish officers, published in Stockholm last year, calls the Soviet Union "The Militarized Community" and asserts that it is the most highly militarized state in the world, that its people are, in the true sense of the word, a people in arms.

Typical of this condition is the "Osoaviachem," or Society for Aviation and Chemical Defense, a national preparedness organization which would make our Navy League seem small indeed. It has 15,000,000 members—one-third of them women—in upwards of 150,000 "cells," distributed in town and country. It possesses a number of military schools, with special schools for flyers and anti-gas troops, as well as many clubs, museums and libraries.

It has presented the Red Army with several hundred planes and has built a number of landing fields. It organizes lectures on military affairs and distributes military posters, books and periodicals. The "cells" give their members training in sharp-shooting, but the most popular subject for study is aviation.

The Soviet authorities assume that the war of the future will involve enormous masses of population, that it will be fought not only on the front, but in the rear of the army. The Osoaviachem is the "driving belt" to prepare the masses, to give all economic activity a war "slant" and to organize gas protection among the population. Every Red Army soldier is required to take active part in his group of the Osoaviachem. Stalin has called it the "first reserve of the Red Army," and a German military critic says it follows the Red Army like a shadow.

Military Power

How strong is the Soviet Union as a military power ? The world is anxious to know. Western Europe has always feared the Russian military colossus with its vast reserves of manpower. But a colossus is clumsy. History has shown that when Russia fought on the inner line, she came out victorious, but when she extended herself too much she lost, as at Sebastopol in the Crimean War and at Port Arthur in the Russo-Japanese War.

Russia's enemies have often underestimated her capacity for defense. Here nature is her powerful ally. The long winters, the magnificent distances (5,000) miles from the Baltic to the Pacific !), and the lack of roads have held her enemies back and have worn them out, as Napoleon learned to his sorrow.

But the Soviet Union may not always be able to choose its own ground and fight its enemies on its inner line. It may have to repel an invasion in the Far East or at some outlying point ; or it may even have to assume the offensive for strategic reasons. And the Soviet transportation system is still weak. It is notorious that under the economic expansion of the Five Year Plans, the railroads have lagged far behind industry. There is a great shortage of locomotives and cars ; the roadbed has not been maintained ; new lines must be built and existing lines double-tracked.

"Even to-day transport cannot cope with the shipments," said Voroshilov last year. "What will be the position to-morrow ? I shall not speak of the demands of wartime, when the strain will be eight to ten times greater than at present."

The Soviet Union has few roads ; of those few only two per cent are paved, and the paving is woefully bad. Americans who travelled

over the highway between Leningrad and Moscow last summer complained bitterly of jolting and blow-outs. No wonder the Soviet army has taken to the air!

Soviet Industry

It is a question, too, how well Soviet industry could stand the strain of war requirements. A modern mechanized army is absolutely dependent upon industry. Great munitions plants have been built in the Soviet Union within a few years by the incredible sacrifices of the population, the ruthless determination of the leaders and the skill of foreign engineers. The need for these plants was the main reason for the precipitate speed of the new Five Year Plan.

But these new industries have not yet been assimilated. Soviet manufacturing is not on a par with that of Western nations. "Why is it," asks Voroshilov, "that the best foreign motors are still lighter than ours, more economical in fuel consumption, more powerful and work longer without repairs?" And he continues: "The quality of our production leaves much to be desired. In many plants coarse work is frequent, which reduces the value of our war orders, and there is still a great amount of waste."

A foreign military observer had just returned from the May Day parade on the Red Square. "A fine show," said he, "and very impressive; but the World War taught me that parades and peace maneuvers give no complete idea of the behavior of troops under fire. The modern soldier must be able to live for days and weeks under a rain of steel, often, left to his own resources, and while suffering hunger, exposure, shock and shortage of ammunition. How the Red Army will meet the hell of modern warfare we shall not know until the time comes."

The Russian soldier of the past has been a splendid fighter. In the Civil War the Red soldiers fought the Whites because they believed they were fighting for their land. The Red Army soldier has been brought up under new conditions, without religion and crammed with Communist dogma. With many—perhaps the majority—the Communist theories are too abstract to have taken much root, and the government's chief reliance will have to be on the man's patriotism and loyalty to the regime.

The million soldiers actually under arms live on an island of privilege in a sea of Soviet misery. They have been well fed, clothed and housed. But in a long war, reserves will have to be called up out of the population. A majority of these will be peasants. The psychology of the peasants has been much upset since 1928 by the ruthless policy of collectivization of their holdings, and it is just settling down.

Under bombardment, will the peasant soldiers still feel that they are fighting for their land? Will the new officers, sprung from the people, with their limited education, prove to be leaders who can command intelligently and inspire the confidence of their men?

Morale of People

What about the morale of the population at home? For years they have been called upon to sacrifice to the limit of human endurance. Things are only just beginning to get better—for some. Can they stand new burdens and the sinking of a standard of living that already is very low?

The head of the Soviet Navy once voiced an article of the Communist faith when he declared: "The superiority in numbers will always be on our side because we can count on a considerable part of the soldiers on the other side of the front as belonging to us." The wishful thinking which fore-saw mutiny in and disaffection behind the enemy "capitalist" lines had more basis in the early period of Soviet rule, before Communism as a world movement lost its force. To-day it is a question whether the shoe might not be on the other foot. How else may the executions following the Kirov assassination be justified?

The Soviet Government for eighteen years have put forth a stupendous effort, by mass propaganda, to create a new psychology. Only war will show how thorough the transformation has been, how firm the faith of the masses is in the Soviet Government as the author of their welfare. The best results may be expected of the 30,000,000 young people between the ages of fifteen and twenty-five who, as the German historian Hoetsch has pointed out, know nothing of the times before the World War, have scarcely any conception of Imperial Russia, possess not the slightest information about foreign countries and have been reared in the doctrines of Communism.

All this is not to disparage the Soviet achievement in preparedness. The Red Army is the smoothest functioning organization in the U.S.S.R.—far better disciplined than the transportation and industry upon which it must rely. The House of the Red Army is the most immaculately kept building in Moscow. There is no question of the loyalty of the new officers and of their eagerness to prove themselves.

However, the sincere efforts of the Soviet Government to keep the peace, their adherence to the League of Nations and their restraint in the Manchurian conflict show that they are not yet ready to meet the supreme test. War might cost the Stalin government its life and plunge Russia again into chaos.

Manchoukuo Abolishing Extra-territoriality

THE first step toward the abolition of extra-territoriality in Manchoukuo has been taken by Japan and it is apparent that in bringing about gradually through the next few years this change the rights and privileges, which hitherto have been accorded by the Government of Manchoukuo to all those alien residents who possessed extra-territorial protection by virtue of treaties with China, will be suspended. It is made clear, too, that in abolishing extra-territoriality the announced purpose of the Government of Manchoukuo is to accord uniform treatment through the various stages of the change to all alien residents of the State, Japanese residents as well as others.

Under date of July 25, an important statement regarding the change was issued by Mr. Charles Bishop Kinney, in charge of the Public Relations Department of the South Manchuria Railway at Dairen. This statement was based upon an unofficial translation of a pronouncement of the Minister of Foreign Affairs of Manchoukuo issued July 1, on the occasion of "the partial abolition of extra-territoriality." Of special interest are those portions of the Minister's pronouncement which deal with the "status of foreign nationals in Manchoukuo other than Japanese." The unofficial translation of the Minister's declaration, as issued by Mr. Kinney, is as follows:

Government Statement

"Availing myself of the occasion when a treaty has recently been concluded with Japan concerning the residence, taxation, etc., of Japanese subjects in this country, I wish to clarify the views and intentions of our Government regarding the status in our country of foreigners other than Japanese subjects.

"At the time of its foundation Manchoukuo issued a statement and addressed communications to the Powers to the effect that it would respect those rights enjoyed by foreign countries by virtue of their treaties with the Republic of China, which the new State is bound to respect according to international law and usage. While some foreign countries enjoy extra-territoriality in China in accordance with their treaties with that Republic, it is self-evident in the light of international law and usage that this State, which has separated itself from, and become independent of, China, is not bound

to succeed to, *inter alia*, such obligations as those imposed by extra-territoriality, and it naturally follows that the nationals of the countries which enjoy extra-territoriality in China do not differ in any respect from those whose countries do not enjoy the same right there, so far as their status in Manchoukuo is concerned.

"This is all the more true when we recall that although more than four years have already elapsed since this State issued the aforementioned statement and communications, no foreign nation, with the exception of a very few, has responded to them which have thus been reduced to a mere, unilateral declaration of the principles of our foreign policy, and those countries that have ignored the said statement and communications are not in a position to claim any rights on the strength of these documents. It is, therefore, the laws and regulations of this country that should govern the status of the nationals of these countries residing in our territory, and in respect of their entry, residence, travel, business and all other matters, they are subject to our laws and regulations.

"Nevertheless, as regards the nationals of the countries which have enjoyed extra-territoriality in the Republic of China, our Government, with the intention of avoiding sudden change in their status, have heretofore, as a matter of favor, accorded them in effect and within certain limits such treatment as if their countries had continued to enjoy extra-territoriality in this country.

"Considerable time, however, has already elapsed since the foundation of the State, its basis has now been solidified, and the adjustment of its various institutions is becoming increasingly marked. Moreover, Japan, which enjoys by treaty extra-territoriality in our country in accordance with the Manchoukuo-Japan Protocol signed on September 15, first year of Tatung (1932), and whose nationals resident in our territory number considerably and whose investments in this country reach an enormous sum, has decided to abolish voluntarily and by gradual degrees her extra-territorial rights in order to assist the healthy development of our country.

"In view of these facts, this Government now regard that the continuation of such a generous treatment accorded to certain foreign nationals is not only unnecessary but is also impedimental to the administration of this State, and have decided to abolish this special treatment by gradual steps. It goes without saying, however, that in dealing with this matter this Government will be guided by the spirit of conciliation.

"Furthermore, it should be added that our Government is desirous of coming to agreement with countries other than Japan regarding the status of the respective nationals resident in each other's territory upon the principle of justice, fairness and equality, and are prepared to consider the proposals for opening negotiations looking toward this end."

How Action is Viewed

Mr. Kinney goes on to say that before the above statement was issued by the Minister for Foreign Affairs of the Manchoukuo Government, he made a hurried trip to Mukden to inquire from the Foreign Consulates and business men, other than Japanese, whether such changes, as mentioned in the Foreign Minister's statement, would have any serious effects among the foreigners in Manchoukuo. Mr. Kinney adds:

"From the various foreign consul-generals I obtained the impression that it will be better for them to wait until the Manchoukuo Government issues a statement on the partial abolition of extra-territoriality, before making any official replies. Some of the foreign consul-generals informed me that as far as foreign business is concerned in Mukden, very little or no trouble is expected, as quite a number of foreign companies had either withdrawn from Manchoukuo, such as the oil companies; or foreign companies had in most cases placed their businesses in the hands of Japanese agencies, such as the Ford automobile company and International Harvester company. I should like to add that prior to the establishment of the Manchoukuo Government, two large private Japanese concerns, the Mitsui and Mitsubishi companies, were and are still agents for a number of foreign manufacturing companies not only for sales in Japan Proper, but also for sales in Manchoukuo.

"With regard to present foreign investments in Manchoukuo, I was informed that there are practically none. The investments made by the various foreign oil companies in Manchuria before they withdrew, are said to have been fairly large, though it is a fact that these investments were only a drop in the bucket when compared with the huge Japanese investments made in Manchuria before September 18, 1931. Negotiations are still proceeding, I understand, between the various foreign oil companies and the Manchoukuo Government to decide on the value of these investments, which Manchoukuo will purchase from the oil companies.

"Regarding the jurisdiction of foreigners, other than Japanese, the Foreign Consulate authorities refused to make any comment other than the remark: 'Let's wait and see what happens.'

"I saw several foreign business men of different nationalities in Mukden and asked them if they feared that their businesses and residential taxes would be raised when extra-territoriality would be partially or wholly abolished by the Manchoukuo Government. The usual answer was something to the effect that, 'if the Manchoukuo Government sees fit to raise the taxes on anything and the Japanese people make no complaint, then we shall also pay and make no complaint. As long as there is a fair play and no discrimination is made between Westerners and Japanese, foreigners will be satisfied.' Business men do not fear that the Manchoukuo Government will discriminate between Westerners and Japanese."

Fifteen Countries

According to a summary written by Takaaki Yokota in the *Economist* of Osaka, a translation of which appeared in the *Japan Advertiser*. The countries which enjoyed extrality rights in the Republic of China when Manchoukuo declared its independence were Japan, Great Britain, the United States, France, Brazil, Norway, Portugal, Sweden, Switzerland, Belgium, Italy, the Netherlands, Spain, Denmark, Mexico and Peru.

The nationals of these countries, even after the establishment of the new State, were in the same position on the whole as previously in regard to extrality, but this was due in no way to any rights derived under international law. Manchoukuo in its statement issued upon its declaration of independence and also in its communications addressed to the Powers stated that it would succeed to the Republic of China's obligations under international law, but to this was affixed the condition that it would do so "according to international law and usage."

It Thus Follows

It is not only the common interpretation of international law but also what is admitted in the light of international usage that a new State, when it has become independent of an old one, is not bound to succeed to, such obligations as those imposed by extrality. It thus naturally follows that the above 15 countries have not recognized Manchoukuo, and though they may claim their extrality from the Republic of China, it is but natural that Manchoukuo, which has declared its independence, cannot approve it.

Nevertheless, Manchoukuo has so far accorded, as a matter of favor and provisionally, these nationals the same special treatment as if their countries had continued to enjoy extrality, this being due to its endeavor not to bring about a sudden change in the status of these foreign nationals and to avert unnecessary disputes over the question. Now that Japan has decided voluntarily to renounce her extrality and has already abolished it partially, the Manchoukuo Government has found that the continuation of such generous treatment may cause an impediment to the administration of the new State, and has decided to abolish this special treatment by gradual steps.

As a practical method for attaining this object, the Government will adopt that procedure whereby Japan's rights have already been partially relinquished. To make this point clearer, in the first stage of abolition, the taxation law and the important industries law will be applied, while in the second stage the police law and others will be applied. In the final stage, judicial power under the civil and criminal codes will be exercised. The above three stages will be put into force completely about the end of next year.

Naturally, what immediately affects the status of foreign nationals as the result of the statement is its application of the law pertaining to taxation and industries. In this respect, Japanese residents are now being taxed on a gradually increasing scale so

that they may not suffer too sudden an increase of their financial burden. It has been decided that they will pay the full amount of taxes within about five years. To all other foreigners this expediency law will be applied, and those foreign nationals may have good reason to be thankful for such a considerate measure.

No Immediate Change in Taxes

Foreign merchants in Manchoukuo have hitherto, though not in the name of taxes, paid in what we might call quasi-taxes in the name of contributions. Thus in the future these payments will have to be paid in the form of taxes, and consequently there will be no substantial change whatever in the amount of actual payment. Perhaps they will have no cause to object to the new decision of the Government.

The same could be said of the application of the industrial law. The foreign oil companies—the Asiatic Petroleum Company, Texas Company and Standard-Vacuum Oil Company—raised objections to the oil monopoly law when enforced, and even lodged a protest with the Japanese Government. Later coming to know that their claim would not be approved by the Manchoukuo Government, these firms withdrew their branches from Mukden.

Foreign nationals in Manchoukuo have a different legal status in and outside the South Manchuria Railway zone. Under the old regime, foreign residents other than Japanese living in the zone demand extrality rights on the contention that the zone itself belonged to the Republic of China, while Japanese nationals claimed that they were exclusively entitled to such rights in the zone. The possibilities were naturally numerous for the occurrence of disputes due to conflict of interests, which caused many of these foreign nationals to live outside the zone. This is the reason why the bulk of foreign nationals are now living outside the zone.

According to the returns made by the Kwantung Bureau, foreign nationals residing within the railway zone totaled 1,088 at the end of last year. Of these, 950 were White Russians, those who enjoyed extrality numbering only 51, including British, 20; French, 6; Swedish, 1; Danish, 1; Portuguese, 1; Americans, 20, and Brazilians 2.

Again, as to foreigners living outside the railway zone, the returns of the Civil Administration Department of the Manchoukuo Government report that there were 66,316 at the end of last year. Of this total, the most numerous were those without any nationality, who totaled 47,631. Next came Soviet citizens, numbering 10,089, and then white Russians with a total of 4,856. Nationals who enjoyed extrality under the old regime numbered only 854, they being: British, 436, including 66 Canadians and 9 Indians; Swiss, 39; Americans, 210; French, 192; Belgians, 28; Italians, 42; Portuguese, 5; Norwegians, 7; Swedish, 18; Danish, 144, and Dutch, 33.

Only Negligible Effect

As already suggested, foreigners without nationality numbered 50,000 showing that the average standard of living of the foreign community in Manchoukuo is low and that their economic influence is proportionally small. Further the very fact that even nationals who enjoyed extrality under the old regime account only for some five per cent of the entire foreign population throughout Manchoukuo explains clearly that the proposed abolition will have only a negligible effect on the foreign residents of Manchoukuo as a whole.

Foreign nationals in Manchoukuo, numbering in all 67,400, are distributed thickly in the north and thinly in the south. Their economic power is concentrated in Mukden and Harbin. Speaking of present business conditions, they have been losing their markets ever since independence in the face of the remarkable advance of Japanese capital and trade. With the exception of German firms dealing in Manchurian agricultural produce and German machinery, whose business interests are well guaranteed by the recent trade agreement, all foreign firms are suffering heavily. If this tendency becomes more pronounced, all such firms it is feared, will have to withdraw one after another from the markets of Manchoukuo.

The Control of Floods

By ARTHUR M. SHAW, New Orleans, La., Former Consulting Engineer to the Chinese National Government

THERE is one harvest for which the world never seems to suffer a shortage. That is the crop of pseudo-scientists who offer an infallible cure and preventive for the floods of our great rivers. The most frequent and persistent of these offerings is that of reservoirs to be constructed along the upper tributaries. A major flood in the Yangtze, the Po, the Mississippi, or the Yellow River is immediately followed by an eloquent appeal for the construction of dams and reservoirs which will prevent all future floods, furnish power for the whole valley, furnish water for the irrigation of all lands which might be benefited thereby, and all but cure the political ills of the country. This pæan of victory and deliverance is usually closed with the statement that all of the claimed blessings can be secured at a cost amounting to less than the loss from one flood.

The fallacy of such claims has been shown repeatedly by competent river engineers who have made a sufficiently complete analysis of conditions of the great rivers of the world to prove that flood control of large river systems, by headwater reservoirs, is not economically feasible, but the control-by-reservoir idea is so persistent that an occasional statement of known facts and familiar arguments appears to be warranted.

Taking up, first, the extravagant claims made for corollary advantages; the service demand for flood control is diametrically opposed to that demanded either by power production or for irrigation. The truth of this statement is readily seen when we consider the manner in which such works would function. Flood-prevention reservoirs should be kept empty for as much of the time as possible in order that their full capacity may be available at times of extreme flow. Exactly the opposite is demanded for the best service in power-production projects and in storing water for irrigation. One project calls for the *detention* of water through a brief, critical period, while the others call for the *storage* of water to meet a future low-water condition. If water were held in the reservoirs, in the interest of irrigation and power production, such value as the reservoirs might otherwise have as a flood-prevention measure would be totally lost, while the operation of the gates in a manner best to serve the main purpose would be fatal to the other interests, for conditions might obtain through a period of perhaps three or four years when no water would be impounded. Neither power nor irrigation projects could be operated successfully on such an erratic supply.

We are often reminded that a number of flood problems have been solved—some partially and others quite satisfactorily—by the upper-reservoir plan. But in every such case, only comparatively small drainage basins have been involved. One of the most notable of these, in the United States of America, is that of the Miami Conservancy District, though the reservoirs are only a part of the whole plan, which includes channel rectification and widening, levees, removal of restrictive bridges and other works.

Another Ohio plan, depending more directly on dams and reservoirs, is now under way. This is described quite in detail in the *Engineering News-Record* of November 1, 1934, in an article contributed by Theodore Knapper of the U.S. Engineer Department. Funds for the work have been made available by the Federal Emergency Administration of Public Works. Conditions were especially favorable for this project, the topography offering suitable sites for reservoirs and dams, land and improvements were of a nature making a high rate of assessment of benefits possible, and Government funds were available at a low rate of interest.

Some of the data from the latter project should be of interest to any who hold the opinion that the same idea might be applied to a river such as the Hwang Ho.

Total number of reservoirs to be created	15
Total area of watershed	2,252 sq. mi.
Total area of reservoirs (at flood level)..	138 sq. mi.
Estimated total cost	U.S.G.$35,290,000.00
Estimated cost per square mile benefited	15,775.00
Estimated cost per acre benefited ..	24.62
Estimated total per hectare benefited ..	60.81

Of the above costs, about 64 per cent is for actual construction: 25 per cent for purchase of land, administrative, and legal expenses, etc.; and 11 per cent for re-location and construction of highways.

In the area involved, water conservation, as well as flood prevention, is of vital importance and definite provision has been made for each. The total capacity of all the reservoirs will be about 1,610,000 acre-feet, of which capacity, 85 per cent will be used for detention of flood waters and the remaining 15 per cent will be held as a water conservation measure. No claim is made that the capacity provided for one purpose will be of any aid to the other.

Not only would the cost of control by reservoirs, as indicated by the foregoing, be prohibitive for great river basins, but meteorological and runoff conditions would be so variable that it would be impossible to co-ordinate the operation of control works to the best interest of each section of the basin. To illustrate, reservoirs constructed for the protection of the important manufacturing city of Pittsburgh might be operated in a manner best to serve the interests of the city but, if so operated, they might conceivably add materially to the flood menace in the lower Mississippi River by discharging their surplus to synchronize with the floods arriving from the Missouri and the upper Mississippi Rivers. The rule of proportion will not work in such a case, any more than it can be applied to a beam. A beam of twice the width will support double the load for a given span but one of twice the width will not support a given load for twice the span. The reservoir system may be perfectly feasible, at a warranted cost, for flood control of a small basin but be entirely impossible of application to a basin several hundred times greater in size.

While it does not appear to be possible to secure protection against the floods of our great rivers by impounding the waters near their source, there are many rivers along which lower-river detention reservoirs, operated in conjunction with levees, might be employed to advantage. This plan has been advocated for the lower Mississippi River, and it may be undertaken at some future date, even though the areas which would have been ideal for such reservoirs have been protected by levees and are now among our most fertile farm lands. On the Yangtze River, natural conditions are even more favorable for the construction of lower-valley control works as the large lakes such as Ting Tung Hu and Po Yang Hu would be ideal for the purpose if their connection with the river were under control. It should be possible to utilize these two large lakes, and dozens of the smaller ones, as detention reservoirs. As compared to the upper-valley control plan, the cost would be insignificant and at least a beginning could be made without straining the present limited resources of the country. The work can be undertaken step by step and the completion of each step will result in a proportionate benefit.

Chinese river engineers have been using this method of control on some of their smaller rivers for centuries and there is no apparent reason why it can not be applied successfully to the Yangtze as an adjunct to the levee system. No river of the type of the Yangtze can be controlled without levees but a reduction, if only of one foot, in the required height of such levees will result in a saving of many millions of dollars in construction cost and a corresponding reduction in river hazards.

Unfortunately, the same conditions do not obtain on the lower Yellow River. The great loads of silt of a unique type carried by the latter stream, together with the topography of its delta section, probably will prohibit the use of detention reservoirs in the lower valley. No other river of the world presents the same problems as the Yellow River, which flows through many hundreds of miles of soil that is extremely friable and of unprecedented uniformity of particles. It is this latter feature, mainly, which has made it possible for the river to defy all past attempts at control of its lower sections. Comparable with it, in some respects, the Missouri River of the United States of America flows through a loess formation from a point in South Dakota down to the westerly part of Missouri and loess bluffs are found again, far below its junction with the Mississippi, in the vicinity of Vicksburg, but these comparatively short sections comprise but a small proportion of the length of the stream. In the lower river, loess occupies an insignificant place in the silt problem, the bulk of the load consisting of fine loam, sand and gravel. The critical velocity, limiting the ability of the river to transport, varies with each class of material and this prevents the extreme concentration of deposit and scour which is found in the Yellow River. The latter may drop almost its entire load of silt as the result of only a small reduction in velocity and, within the time of one brief flood, the increased velocity may cause it to scour out its effective channel to more than twice the size which existed just prior to the flood. These progressive and rapid changes in river section are well illustrated by river surveys which already have been made.

The new National Hydraulic Laboratory should be instrumental in establishing many facts which will be essential in reaching a better understanding of conditions governing the control of the Hwang Ho and other rivers. Co-ordination of investigations with those which are being made in Germany and the United States of America should be sought in order that duplication of effort may be avoided and economy and effectiveness be secured.

Even with the avoidance of all undersirable duplication, there still remains an ample field for study. German and American engineers (with the Germans as pioneers) have made available a tremendous volume of data concerning the operation of river laboratories and results obtained by them but, with all this, only a small start has been made in the reduction of river control to an exact science.

There never has been devised a system of laboratory procedure which will make it possible to determine with exactness what will occur in an actual river, though it has been fully established that glaring errors in design, costing millions of dollars, may be avoided by carefully planned and executed laboratory experiments costing only a few hundred dollars, or at the most, a few thousand. The application of methods developed by the use of a small-scale model to a full-size river is described in a recent article by Lieutenant Herbert D. Vogel of the Engineer Corps, U.S. Army ("Hydraulic Laboratory Results and Their Verification in Nature," published in Proceedings of the American Society of Civil Engineers, January, 1935). This paper is based on experiments made in the laboratory at Vicksburg and the adaptation of the results of these experiments to a number of difficult points on the Mississippi River.

As the Vicksburg laboratory is located at one of the few points where an unlimited supply of loess soil is easily obtainable, a close co-operation between that institution and the staff of the new Chinese laboratory would seem most desirable and mutually beneficial.

In my opinion, the problems of flood control as presented by the Yellow River are the greatest that confront the river engineers of this age and I would venture the prediction that the solution of these problems will be reached only by the most intense, scientific study of the principles of silt transportation and deposition, the results of these studies forming the basis of channel design, control works, and maintenance which will provide a more equable velocity of flow at all stages of the river. The engineer, or group of engineers, who solve these problems will be entitled to the greatest honors which their country can bestow upon them.

BIG SHIPBUILDING PLAN.—It is reported that the Nanking Government has decided to set aside $30,000,000 for the China Merchants' Steam Navigation Company for the building of 26 new ships, one of which should be a sea-going vessel of at least 5,000 tons.

Two-thirds of these ships will be put on coastal runs while the remainder will be river craft.

The shipbuilding plan is scheduled to be carried out within a period of six years.

NEW SHIPS FOR D.K.K.—Permission to add a 2,200 ton passenger ship and five freighters to its fleet of vessels operating on the Dairen-Tientsin run has been received by the Dairen Kisen Kaisha from the South Manchuria Railway Company, its parent firm.

The D.K.K. has already asked dockyards in Japan to submit bids. The passenger vessel will have a speed of 15.5 knots. Of the freighters, two will displace 2,000 tons and have a speed of 14.5 knots, while two others will have a tonnage of 4,000 and a speed of 12.5 knots. The remaining vessel will be an oil tanker, capable of 15 knots.

History of General Motors, Japan, Ltd.

THE formal opening of General Motors, Japan, Ltd. was held on April 8, 1927, attended by His Excellency Governor Nakagawa, Assistant Mayor Kagami of Osaka and other Japanese dignitaries of Osaka and Tokyo. Mr. H. B. Phillips, Managing Director made an address of welcome and then presented a golden key to the plant and His Excellency performed the ceremony of officially opening the door. The guests then made their way to the power house, where with due ceremony Mr. Kagami threw in the master switch which set all the machinery of the plant in operation.

At that time the total number of employees on the payroll was just over 200, which compares with 750 employees at the present time.

Production capacity increased accordingly and the plant produced its 1,000th car in May, 1927. The 5,000th unit was produced in December, 1927, the 10,000th in June, 1928, the 50,000th in July, 1931 and the 100,000th car will be produced during 1936.

The establishment of General Motors, Japan, Ltd. in Japan has given the Japanese automobile industry the benefit of American mass production methods and the manufacture locally of automotive vehicles of equal quality and performance. Quite logically many parts of the General Motors products are imported parts, which can only be fabricated from the raw material by utilizing extremely expensive machinery and dies, the cost of which if borne by the Japanese market alone would put the price of General Motors cars and trucks far above prevailing prices.

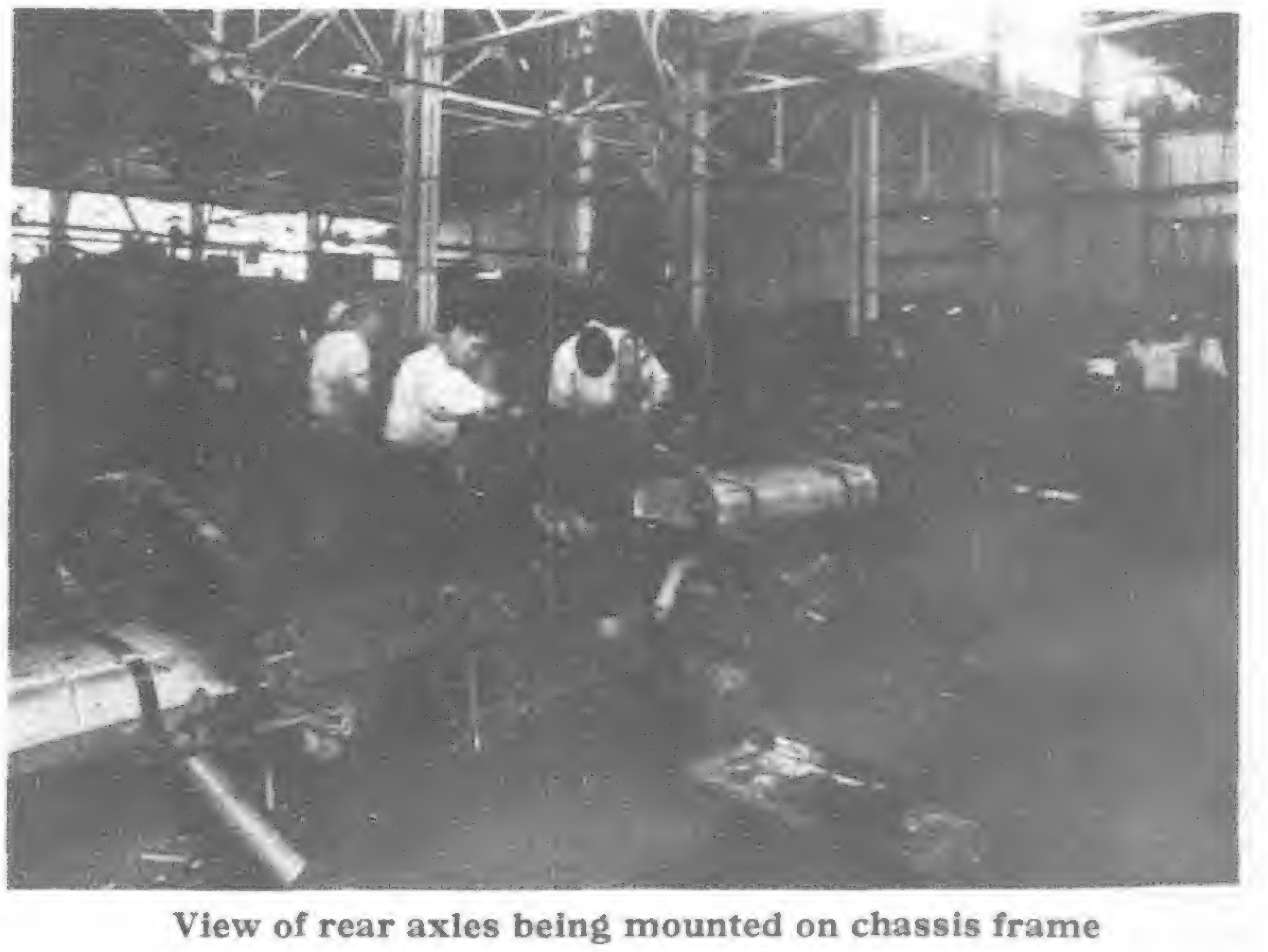
The second and equally important advantage of this manufacturing plant of General Motors to Osaka and the Empire is the creation and development of efficient Japanese executive and skilled labor personnel who are being trained and developed in an essentially key industry, the automobile industry, one of the leading manufacturing industries of the world to-day.

A further important point, besides the advantages of mass production methods and the employment of local personnel, is the purchase of Japanese materials in Japan. The policy of General Motors, Japan, Ltd. is to substitute Japanese materials in each of its products just as soon as local materials meet the test of quality. At the present time these include such essential parts as tires, upholstery materials, glass, batteries and various chassis parts.

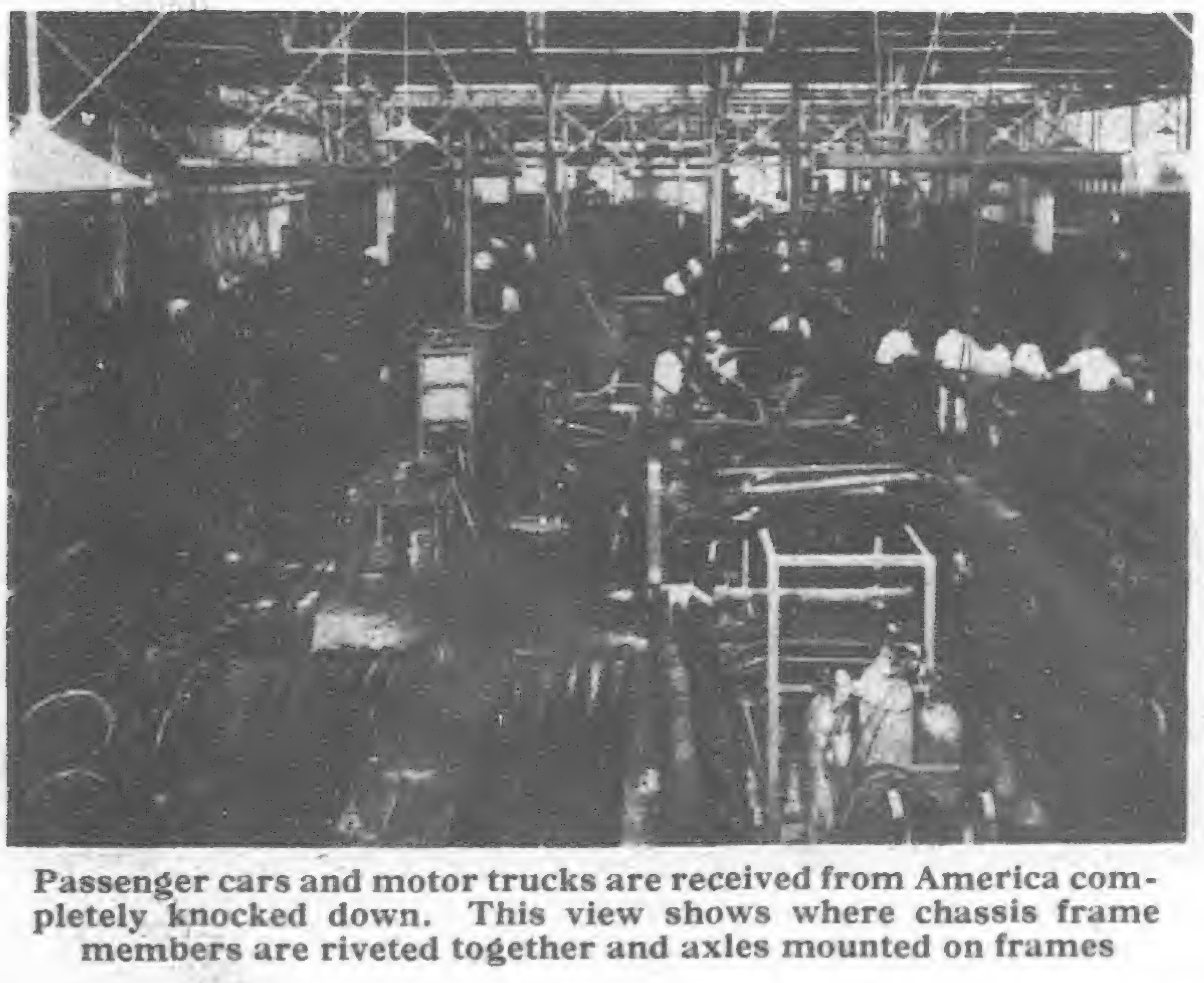
The contribution of General Motors, Japan, Ltd. to the development of the automotive industry in Japan as well as to the general economic welfare of Osaka is substantiated by the following figures of local expenditures for the period from 1927 through 1935:

Import duty	Y.25,500,000.00
Taxes	6,050,000.00
Freight	5,400,000.00
Insurance	375,000.00
Purchases of domestic materials	17,290,000.00
Salaries and wages	12,622,000.00
Other commercial expenditures	9,600,000.00
Total	Y.76,837,000.00

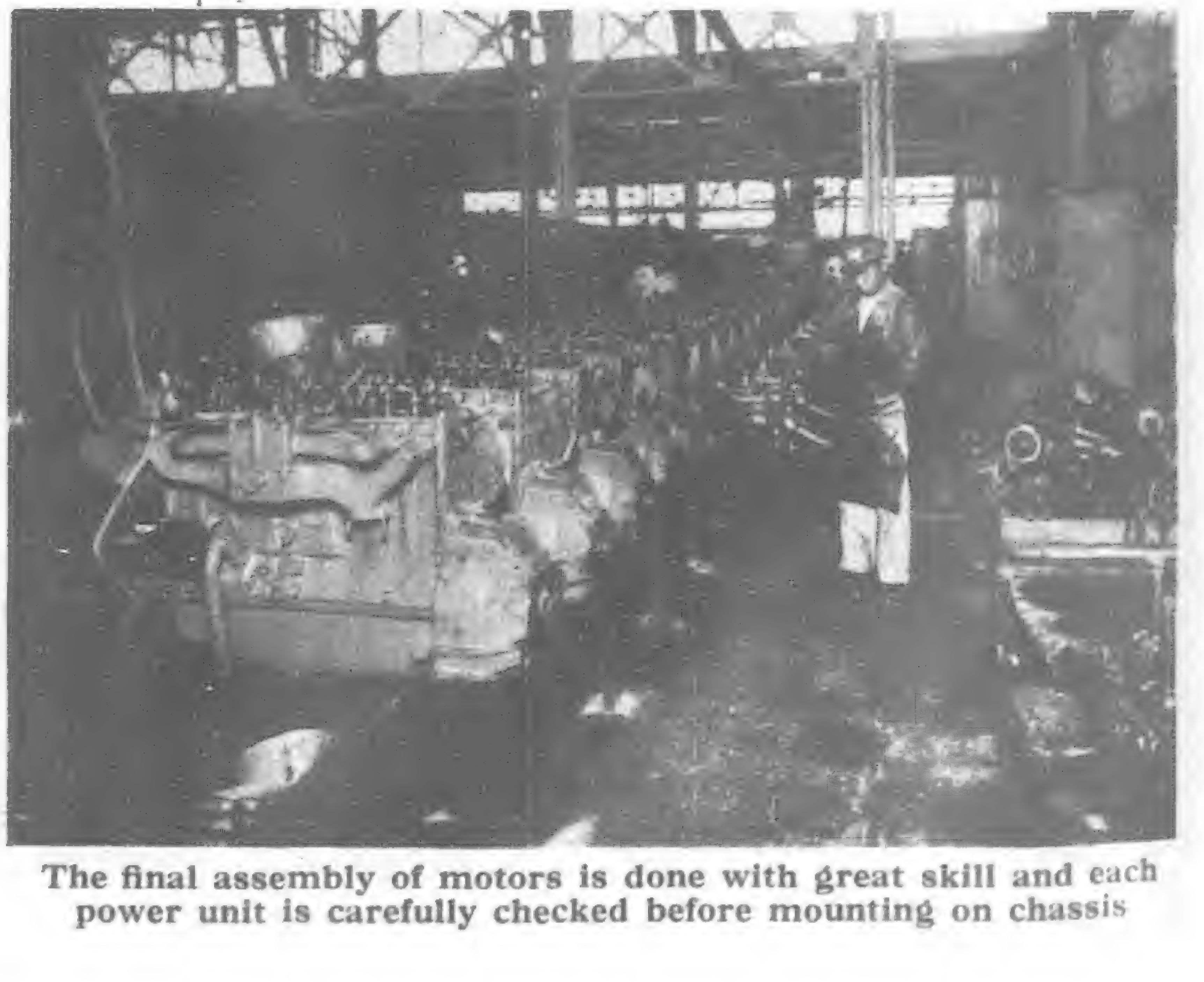
Eastern approach to main factory



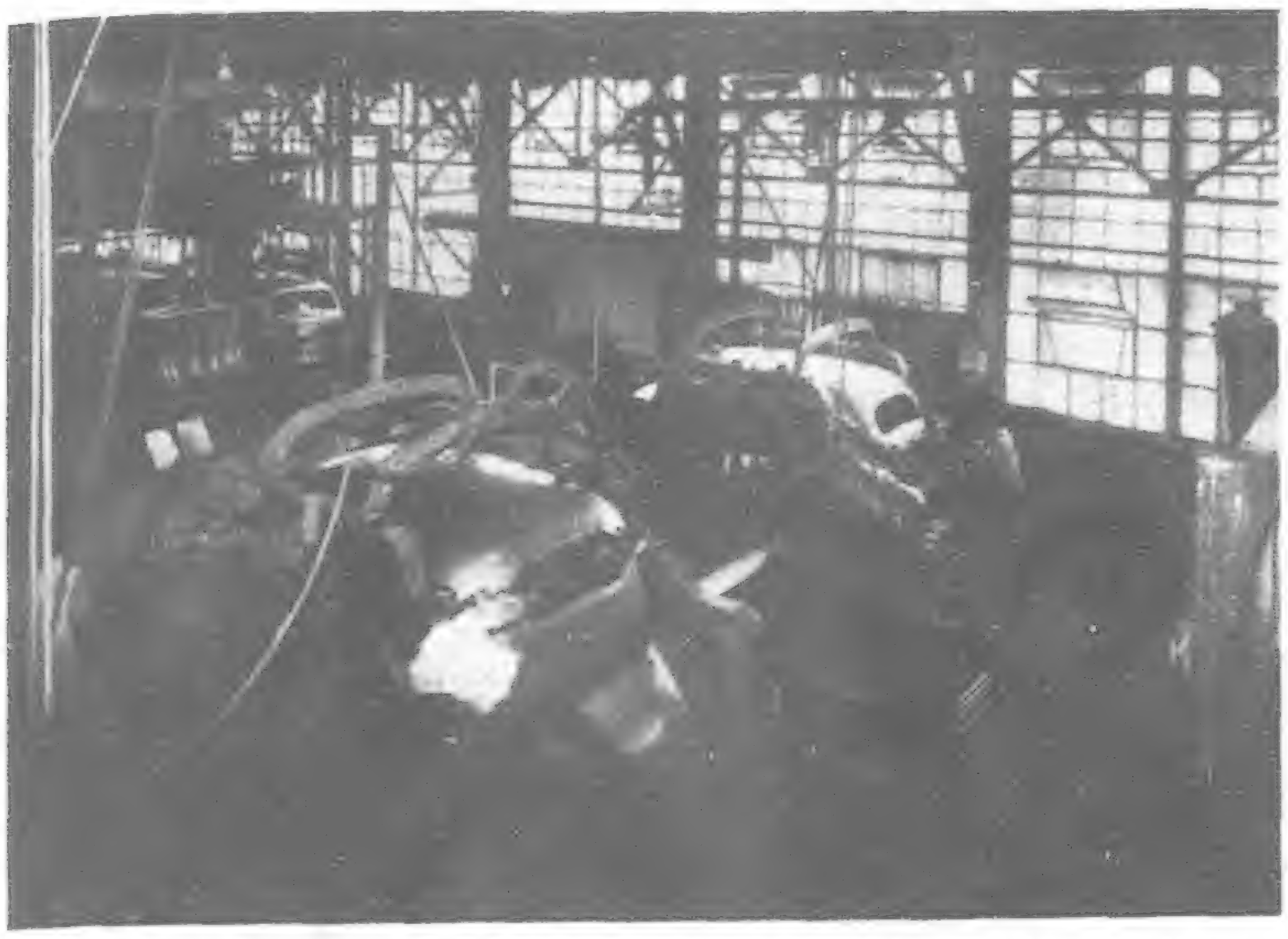
View of rear axles being mounted on chassis frame



Passenger cars and motor trucks are received from America completely knocked down. This view shows where chassis frame members are riveted together and axles mounted on frames



The final assembly of motors is done with great skill and each power unit is carefully checked before mounting on chassis



Body shop showing sheet metal sections fitted in jigs for welding. Assembly is done by special automatic welding tools developed by Fisher Body Company. One of the great achievements in automobile making has been the perfecting of Fisher bodies with all steel turret tops

The greatest care is exercised in checking all General Motors cars for mechanical perfection before they are delivered to dealers. Skilled inspectors examine cars from above and below, as shown

Had the company not established a factory in Japan but instead had merely imported the finished products from abroad, the major part of these expenditures would have been lost to Japan. It is not too much to say that General Motors, Japan, Ltd. has benefited Japan considerably by its operation of an assembly plant in this country.

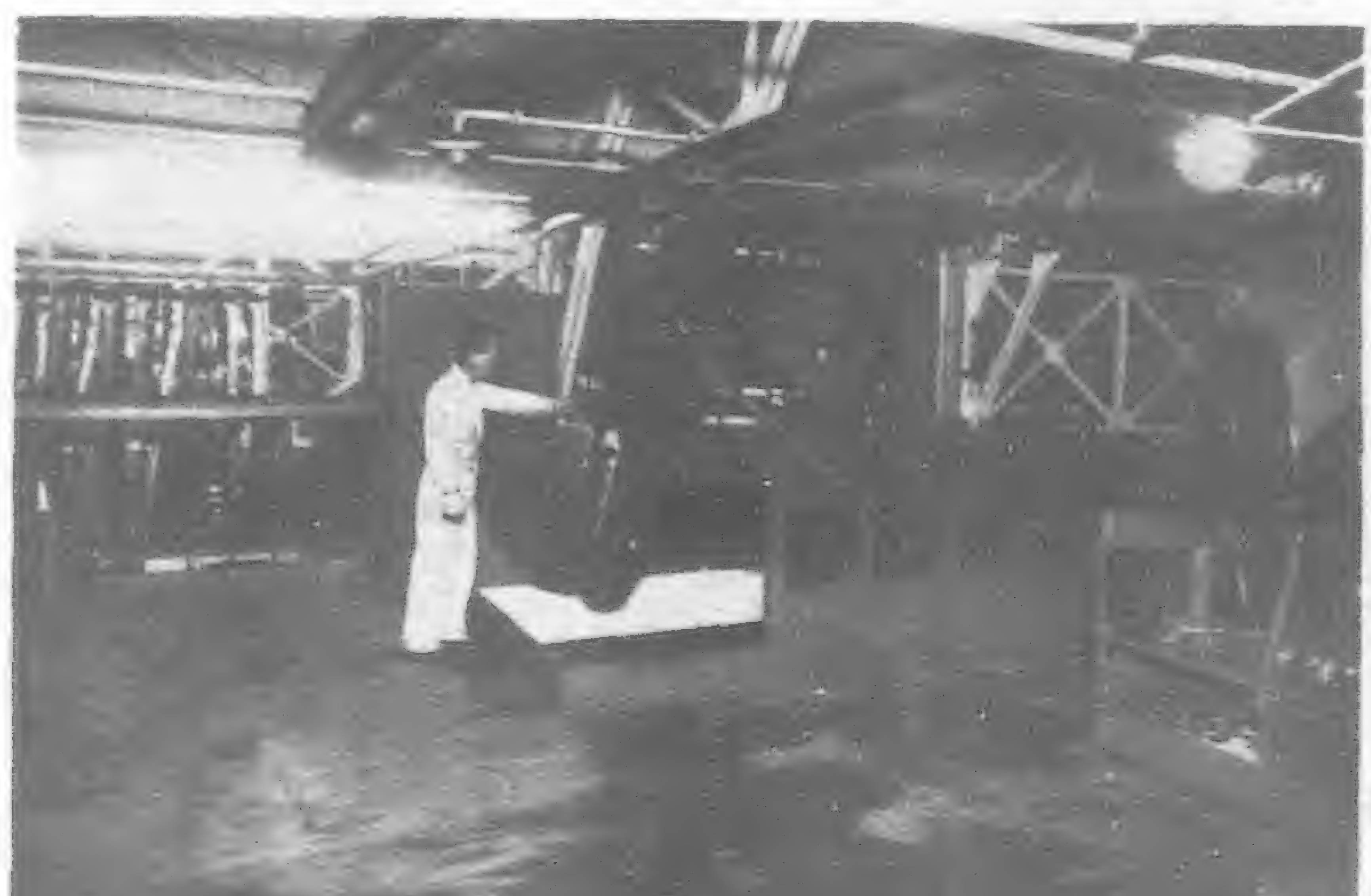
Beyond these important factors, it is very interesting to observe that General Motors, Japan, Ltd. does considerable export business from Osaka to such important markets as Manchoukuo and China, these cars and trucks having been built in Japan by Japanese labor, which contributes to the development of the Empire export trade. This export volume, does not include Chosen and Taiwan, in which sections of the Empire, General Motors, Japan, Ltd. also does a large volume of business.

Like many other manufacturing industries, in the automobile industry distribution is very closely allied to production. The distribution and sales of General Motors cars and trucks have increased rapidly through a dealer organization consisting of some 120 retail outlets. These retail outlets or showrooms extend from Karafuto in the north to Taiwan in the south and from the most eastern point of Honshu to Chosen in the west. In Manchoukuo, General Motors, Japan, Ltd. has appointed independent dealers, extending from Dairen in the south to Harbin in the north to Chengteh in the west. All of these dealers operate entirely as independent business organizations selling General Motors products in their allotted territories on an exclusive basis. They are merchants of the first order and hold important positions in their communities because of their association with the automobile industry and their modern development according to best business practice. A large number of these dealers have represented General Motors ever since their original appointment in 1927.

An automatic electric welding machine especially developed by Fisher Body Co. for assembling gasoline tanks. Circular electrodes under high pressure weld the tank flanges together as shown in this picture

Each of General Motors' dealers, besides having showrooms, maintain modern service stations where all cars in their territories may receive service to the end that they may be kept

Running boards, fenders and radiators are completely assembled into one unit prior to mounting



Complete radiator, fender and running board assembly being lowered into position for mounting

running continually 365 days of the year and 24 hours of every day if necessary.

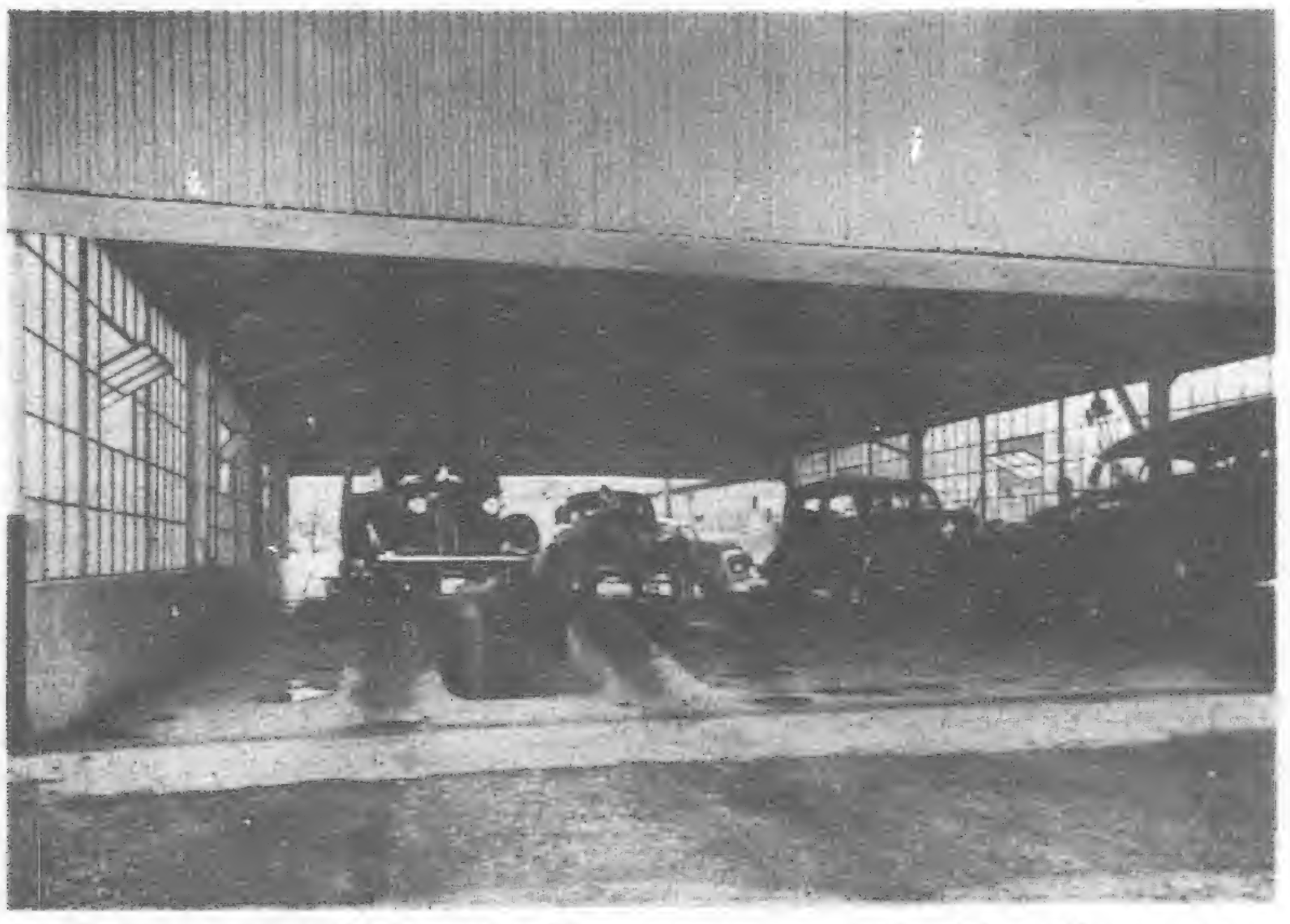
Another important adjunct to the equipment of its dealers is their parts departments where genuine General Motors parts are always kept in stock. The dealers in turn drawing on General Motors, Japan, Ltd.'s large parts depot for replenishment.

The automobiles merchandised by General Motors, Japan, Ltd. cover the entire price range from the low price Chevrolet to the high priced Cadillac and comprise the following :—

Chevrolet, Pontiac, Oldsmobile, Buick, La Salle, Cadillac, Vauxhall and Opel.

The truck line is represented by Chevrolet, Oldsmobile, G.M.C., Bedford and Blitz. All of which truly reflects General Motors' motto, " A Car for Every Purse and Purpose." The products of General Motors, Japan, Ltd. are conspicuous throughout the Japanese Empire and Manchoukuo in taxi and bus operation, trucking and every field of automotive activity. Not only are General Motors products widely used by the general public in Japan and Manchoukuo, but they are also used by the National, Prefectural and Municipal Governments.

That its products comprise a large percentage of the automotive units used by the taxi, bus and truck operators and Government

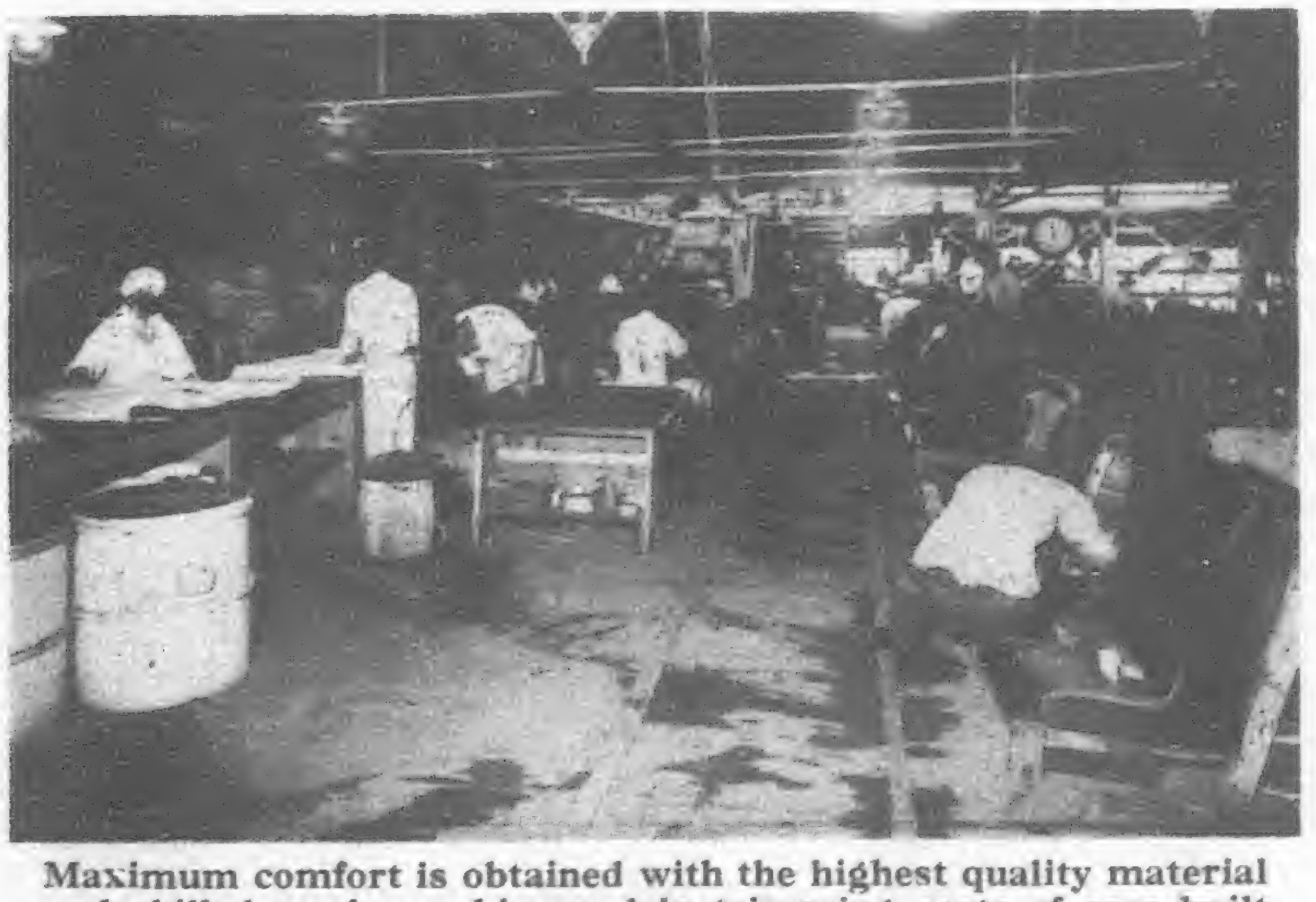


Brakes are equalized and wheels are accurately aligned by means of mechanical precision equipment

Fisher bodies now are equipped with all steel doors which are carefully fitted to bodies as shown in this picture

Starting point on moving conveyor line showing a truck chassis in course of assembly prior to installation of the motor

This is a view of the cutting and sewing division of the trim shop. Material for 36 passenger cars can be cut at one time



Maximum comfort is obtained with the highest quality material and skilled workmanship used in trimming seats of cars built by General Motors

The superior quality and beautiful Duco finish of General Motors passenger cars is obtained by the great amount of careful work done in preparing the undercoat as illustrated in this picture

officials is a source of much gratification to General Motors, Japan, Ltd. who at the same time feels a corresponding obligation to maintain the quality of its products at the superior level which has won for them the preference of so wide a clientele.

Although General Motors, Japan, Ltd. may be classified primarily as an assembly plant and not a manufacturing plant, the motor assemblies, transmissions, rear axles, body parts, and various other component parts are imported from America.

General Motors, the world's greatest builder of automobiles and trucks was founded twenty-eight years ago. Since that time the growth of the organization has contributed a unique chapter to American industrial history.

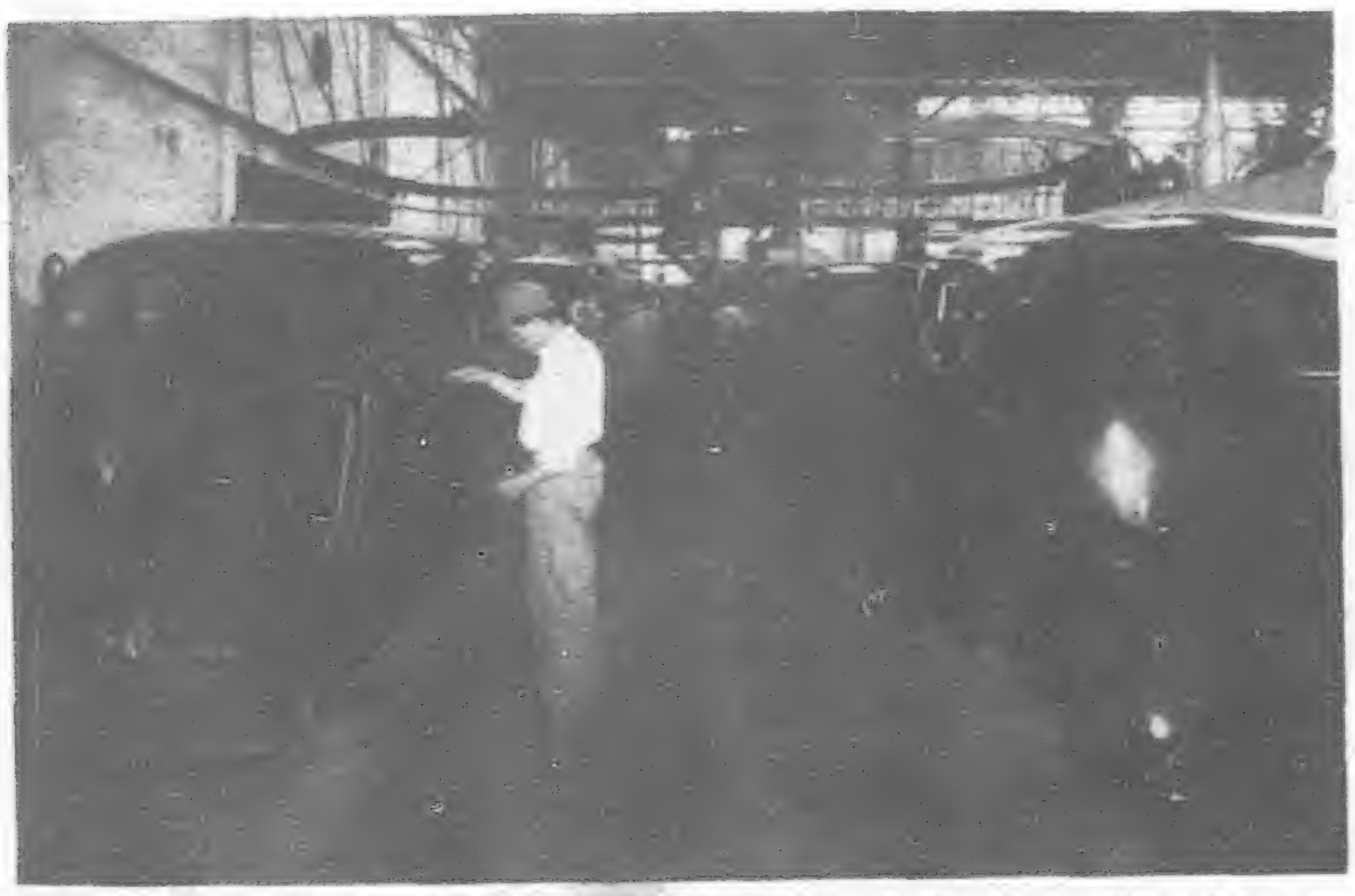
General Motors has worked its way steadily forward to a place where its leadership in many of the most exacting branches of production and distribution is taken for granted and where it offers the world a wide variety of merchandise and service.

Scientific research, close attention to dealer and consumer needs, and constructive public policies are among the factors accounting for General Motors' present strength.

The older divisions of General Motors, go back to the early days of the automotive industry, and some of them far beyond. Their taproots reach down to carriage and wagon building, to firearms, stationary and marine gasoline engines, milling machinery, roller bearings, bicycle gears, lathes, etc. Their branch roots

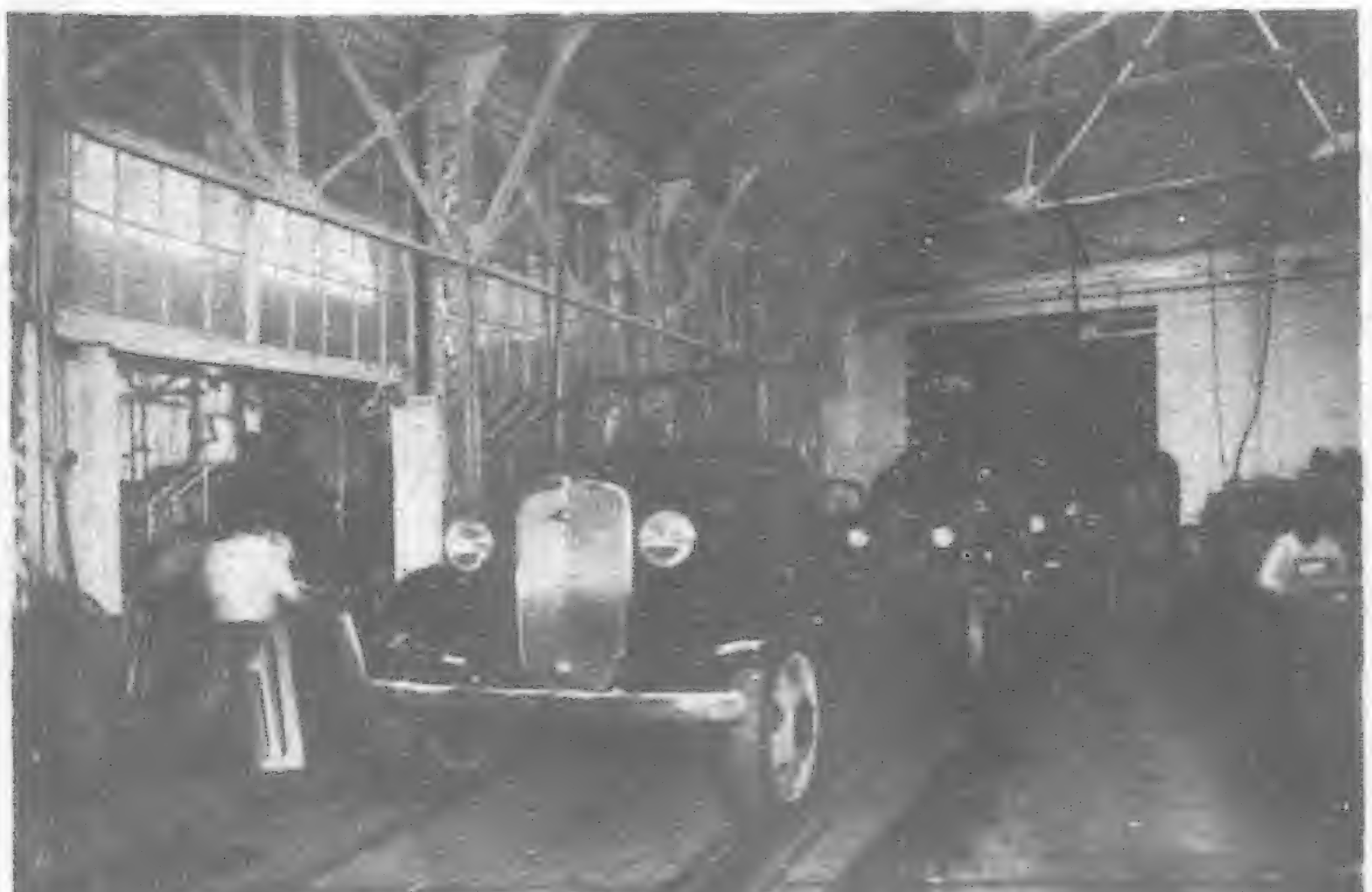
The Duco process is skilfully applied by compressed air. Each Fisher body receives a minimum of ten coats to guarantee long life and permanent luster

Fisher bodies are completed in this division of the trim shop where glass is fitted and all interior work is done to harmonize with the quality of General Motors cars



The final polish is given by power buffing wheels and striping is done by hand

Showing how a finished Fisher body is lifted by air hoist and carried to the conveyor line for mounting on chassis



A completed Chevrolet truck leaving the conveyor line

View of cars leaving brake and wheel alignment testing machines

stretch back to the beginning of scientific experiment, since the self-propelled vehicle is the child of physics and chemistry.

In following the rise of General Motors against the broad background of latter day industry and science, one sees that the large scale production is the inevitable result of generations of inventiveness, organizing ability, and the willingness of capital and labor to pull together towards common objectives. Among these objectives are the lifting of standards of living, the satisfaction of old wants with less labor, convenience and culture. To steady economic life is perhaps as real an industrial need to-day as mass production was twenty years ago, as real a need as the automobile was forty years ago, when men travelled at the pace of the horse over wretched roads.

General Motors leadership in the automotive industry to-day is due to the labor of many thousands of men and women in factories, laboratories and offices in the field ; of workers in all branches of production ; of craftsmen and designers striving to combine beauty with serviceability ; of scientists patiently attacking problems of metallurgy and engineering ; of foremen, superintendents, and inspectors ; of dealers and salesmen in every land searching for sales of its products.

In the manufacture of its products, raw material is supplied from every quarter of the world. This raw material is converted into intricate precisioned chassis, motor, transmission, rear axle parts, construction of bodies, body hardware, glass, electrical parts, bearings, etc., with manufacturing facilities without equal in the entire automotive industry.

The combination of all of these contributing factors permits General Motors to offer to the automotive operators the finest line of automobiles, buses and trucks that science, engineering and research can produce.

Furthermore many great plants, strategically located with respect to materials and transportation enable General Motors to offer these quality products at prices which are surprisingly low.

All General Motors units from the lowest priced Chevrolet to the highest priced Cadillac are manufactured to the highest standard of precision. Every step in the production of the component parts receives the closest scrutiny. In the Chevrolet factories alone one of every ten men is employed as a carefully trained inspector.

General Motors have the finest engineering organizations in the industry together with thousands of skilled and experienced craftsmen producing the automobiles and trucks that have won yearly world-wide recognition for fine, dependable performance and economy of operation.

General Motors maintains the finest Research Laboratories of any automotive organization in the world. Tests of every kind are made—how to develop better steel, how to improve lubrication, carburetion, economy, exterior design, brakes and a hundred and one other large and small details to constantly improve General Motors products each year.

Among the outstanding contributions of General Motors in the research field are the following, some of which have been the work of the Research Laboratories, some the work of divisional staffs, and others the result of joint efforts between the Laboratories and the divisions :

1909-10	Battery ignition.
1911	One-piece spark plug shell.
1911-12	Self-starter.
1915	Tilt-beam headlights.
1920	Cellular type radiator.
1923	V-type fan belt.
1923-24	Perfected four-wheel brakes for quantity production.
1923-24	Ethyl " knockless " gasoline.
1924	Harmonic balancer, to eliminate difficulties caused by torsional crankshaft vibration. Duco lacquer finish.
1925	Crankcase ventilation.
	Thermo-control of water-cooling system.
1926	Balancing crankshafts in quantity production.
1927	Chromium plating.
	Engine driven fuel pump.
1928	Synchro-mesh transmission.
1930	Silent proppet valve mechanism.
1930-31	Carburetor intake silencer.
1932	Automatic choke.
	Super-safe headlights.
1932-33	Fisher no draft ventilation.
1933-34	" Knee-action " front springs, and improved weight distribution.

Hand in hand with the Research Laboratories, General Motors operates the first as well as the largest automotive Proving Ground in the world. Here day and night, summer and winter, cars are put through their paces.

In this 1,268-acre outdoor laboratory, there are straight roads and curved roads, bumpy roads and smooth ones, hills and speedways, cobblestones, Macadam, gravel and dirt trails—and a " bathtub " through which cars can be driven at any depth or any speed. The total distance travelled by all cars driven on the Proving Ground totals millions of miles per year. And the results of these tests are recorded electrically, mechanically, photographically, with utter impartiality. Within a few weeks, a car will amass a mileage equal to years of ordinary use in the hands of an owner.

The Proving Ground serves several purposes :—

First : it provides a place where a final check—the test of actual experience—can be made on every new model and every new device. It serves as a thorough safeguard for buyers of General Motors cars, to protect them from experiments of doubtful value. The engineers of every car division of General Motors bring their experimental models here to test them before they are put into production. This gruelling testing practice insures " stamina " which is a requirement for all General Motors products.

Second : it provides an accurate means of measuring the comparative performance and endurance of General Motors cars and contemporary products, both American and European.

Third : it provides a place where future improvements may be incubated and developed.

The Proving Ground is now more than ten years old, and what a story of motor-car development one could uncover from its files ! Every new device, every novelty, every principle of engineering and construction, every kind of material introduced by the industry in this time has been tested here. And in those year-by-year records you could trace the steady advance in speed—in safety—in comfort—in reliability—in economy of cost and operation—in value—which provides the best evidence of all as to what Research and the Proving Ground have done for General Motors car owners.

Supplementing the work of the Research Laboratories and the Proving Ground, there is another activity which plays an important part in broadening General Motors' service to the public. This activity is known as Customer Research—" the third link in General Motors Fact Finding."

To operate successfully to-day a large manufacturer must know what people are thinking, what they want, what they like or dislike about the products he makes for them, how these products can better serve people's needs and desires.

Mass production and world-wide distribution, notwithstanding their numerous advantages, tend to create a gap between the consumer and those responsible for guiding the destiny of an institution. There is a need for something to fill the place of the close personal contact which existed automatically back in the days of the small shop.

Customer Research serves as an independent outside check on what the research men and the stylists are doing behind closed doors. It tells us which of the new things that are continually being developed will be most acceptable to the motoring public.

In other words, it enables us to measure trends in design, engineering developments and new style creations against the needs and tastes of the actual user—not after the cars are on the market, but well in advance of production.

It guides policies, such as the practice of giving a choice between different types of engines, different numbers of cylinders, different body styles, etc., on different General Motors cars.

Sometimes it points the way to new things which research can develop—and this provides added assurance that General Motors products will always be kept abreast of the times.

Customer Research is, in brief, another valuable way of avoiding guesswork—of keeping an ear to the ground, while we work with an eye to the future.

General Motors sells more automobiles and trucks each year than any other manufacturer in the entire world making it the leader in the automotive industry.

During 1935 total sales to dealers, including Canadian sales and overseas shipments amounted to over 1,700,000 cars and trucks. It is interesting to note that during 1935 General Motors appropriated $50,000,000 to reorganize, readjust and expand its manufacturing facilities.

(*Continued on page 366*)

The Ujigawa Electric Power Co. of Osaka

Enterprise Incorporated Thirty Years Ago Serves Seven Cities and 241 Villages in Eight Prefectures

THE primary aim of the Ujigawa Electric Power Company is to generate electricity from the waters of Lake Biwa and transmit that electricity to Osaka, Kyoto and their neighborhood.

Lake Biwa, which is considered the largest lake in Japan, has, from time immemorial, been used for the purpose of irrigation, navigation and fishing, but, with its exploitation for hydro-electric purposes, it fills a greater place than ever in Japanese industrial life.

Lake Biwa possesses great natural beauty and, down through the ages, has been an inspiration to the country's greatest poets, and men of letters. This sheet of water which is situated in the district of Ohmi, is 14 miles from east to west and 40 miles from north to south; it covers an area of 274 square miles, and, with the addition of all connecting streams in the Ohmi District, has a run-off area of 1,238 square miles and a total volume of 1,000,000,000,000 cubic feet.

One statistician has calculated that the volume of water in one inch on the total surface of the lake amounts to 780,000,000 cubic feet.

On account of the gigantic run-off area, the volume of water in the lake is not affected by drought.

Since the time the government constructed the Araiseki Weir (spillway dam) at Nango, on the Seta River (the lower part is called the Uji River) in the 37th year of Meiji (1904), Lake Biwa has come to be considered the most ideal place in Japan for a reservoir and hydro-electric activities.

Characteristics of the Company

Most of the electricity supplied by the Ujigawa Electric Power Company is of hydraulic generation. The Company's principal power houses are on the banks of the Uji River and in the district of Yamato.

As stated elsewhere, the output of the Company is at no time in jeopardy, as, regardless of how long a drought may last, the water level of Lake Biwa will not fall to any perceptible degree.

Yamato Province which is virtually a thick, unexploited forest has a vast amount of rainfall, and is naturally a propitious location for a hydro-electric undertaking, on account of its enormous volume of water and high level.

The District in which the Company sells most of the electricity it produces, has an extremely voluminous demand for power and light on account of the multifarious industrial activities centered in that part of Japan. On account of the proximity of the power stations and the points supplied, the Company can maintain a minimum of delays and deficiencies in transmission and give its customers the utmost satisfaction. These are some of the prime characteristics of the Ujigawa Electric Power Company.

Organization and Undertakings

The Ujigawa Electric Power Company, Ltd., was incorporated on the 25th day of October, 1906 (the 39th year of Meiji).

Business transacted includes :—

(1) Supplying electricity and accessories,
(2) Electro-motive industry,
(3) The purchase and sale of electrical machinery and appliances,
(4) Transportation business by electric railway and/or by motor vehicle.
(5) Investments in electrical undertakings.

The Company's first project was the induction of 2,000 cubic feet per second of Lake Biwa water from Nango dam, Ishiyamamura, County of Shiga, Shiga Prefecture, to a 29,000 kw. power house constructed in the town of Uji, Kyoto Prefecture, and the transmission of the electricity generated there to Osaka and Kyoto. Permission for this project was obtained from the Government in December, 1907 (the 40th year of Meiji). Actual construction work started the following year and was completed in July, 1913 (the 2nd year of Taisho). Business was commenced on August 1 the same year. This was the Company's first hydro-electric venture. At that time, power for industrial purposes, except for lighting and electric railways, was very little in demand. Later, when the Company's efforts to spread the use of electro-motive power began to exceed the supply and the Company was forced to increase output. To this end, the capacity of Uji Power House was increased to 32,000 kw. in August, 1922.

To meet the electrical needs at the time of the European War, a steam power house was projected on the right bank of the Shirinashi River, up to Osaka Harbor, work on this plant was commenced in February, 1918 and completed in April, 1920. This was named the Fukuzaki Steam Power House. Its capacity of 30,000 kw. was, in April, 1923, augmented by a further 10,000 kw.

In September, 1920 (the 9th year of Taisho) a permit was received for the construction of the Shizugawa Power House (28,000 kw.) about a mile higher than the Uji Power House. Work on this plant was completed in March, 1924 (the 13th year of Taisho). This was the Company's second hydro-electric venture.

Ohmine Power House (16,000 kw. at maximum load) which was under construction since October, 1923 (the 12th year of Taisho) was completed and put into operation in August, 1926 (the 15th year of Taisho). The work was considerably facilitated by the dam at the intake of the Shizugawa Power House. This is the fourth hydro-electric venture, No. 3 being merely embryonic at present.

In October, 1927, was completed the construction of a steam power house (60,000 kw.) on the left bank of the Kizu River, Osaka City, for the purpose of insuring an adequate supply of power in the dry season and also to meet the electrical needs rapidly increasing. This is called the Kizugawa Steam Power House. Its capacity of 60,000 kilowatts was augmented by a further 3,000 kw. in September, 1934.

New Head Office Building of the Ujigawa Electric Power Company, Umegae-cho Kitaku, City of Osaka

The following concerns have been amalgamated with the Ujigawa Electric Power Company and they are

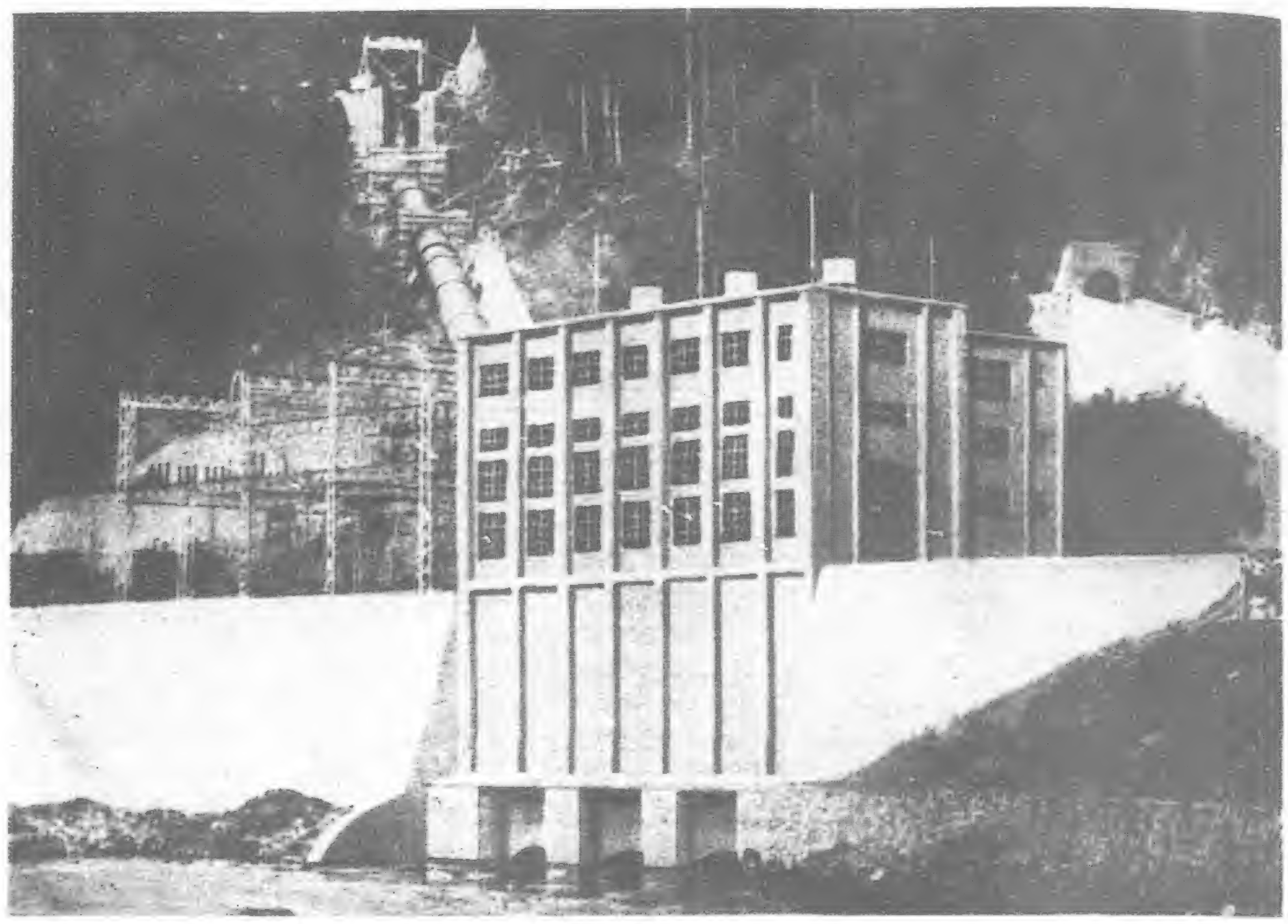
retained as our branch offices for the purpose of conducting business within their own districts respectively :

(1) THE OHMI HYDRO-ELECTRIC COMPANY, which supplies light and power to districts to the north-east of Lake Biwa. The merger was consummated in September, 1921 (the 10th year of Taisho). Simultaneously, the Company's capital was increased to Y.31,400,000.

(2) THE YAMATO ELECTRIC POWER COMPANY, which supplies light and power to most of the county of Yoshino, Nara Prefecture. The merger took place in October, 1921 (the 10th year of Taisho), and the capital of the Company was again increased to Y.37,650,000.

(3) THE KUMANO ELECTRIC POWER COMPANY, intended to supply electric light and power to Wakayama and Miye Prefectures. The merger took place in May, 1922 (the 11th year of Taisho) and the Company's capital was raised to Y.38,700,000.

(4) THE TAISHO HYDRO-ELECTRIC COMPANY, which supplies electricity to the city of Kobe. The merger took place in October, 1922 (the 11th year of Taisho) and the capital of the Company was raised to Y.41,366,650.



The Suriko Power Plant

The capital of the Company was further augmented to Y.85,000,000 in November, 1922 (the 11th year of Taisho).

(5) THE HYOGO ELECTRIC TRAMWAY COMPANY AND THE KOBE-HIMEJI ELECTRIC RAILWAY COMPANY, which are well known as the Electric Car Services running along the shore of the Inland Sea, with a total distance of 35.78 miles between Kobe and Himeji cities. Along these lines are many places both famous for their scenic beauty and of historical interest, the principal ones being Suma, Maiko and Akashi which are admired by all the people as the best pleasure resorts in Japan all the year round and also for their natural beauty.

The mergers took place in January and April, 1927 (the 2nd year of Showa) and the construction of the through traffic service between the tram and railway lines to join both for the purpose of increasing the through passenger and freight traffic over the whole system was so far completed that it was put into operation in August, 1928, and its business is conducted by the Electric Tram and Railway Department of the Company newly established.

Simultaneously, the Company's capital was increased to Y.92,-500,000.

However, under the resolution of the Ordinary Meeting of Shareholders which was held on October 28, 1932, Electric Tram and Railway Department's business concession and its properties were sold and assigned to the Sanyo Electric Railway Company, Limited (a total amount of Y.30,000,000 in capital).

The Promoter's meeting of the Sanyo Electric Railway Company, Limited, was held on June 5, 1933, and on the same day the sale and assignment were executed. Ujigawa Electric Power Company has substantial holdings in the stocks of Sanyo Electric Railway Company

(6) THE KUSANOGAWA ELECTRIC POWER COMPANY, which supplies electricity to the north-eastern districts of Shiga Prefecture.

The Company obtained a permit from the Ministry of Communications on March 7, 1935, to acquire the business of Kusanogawa Electric Power Co., which was carried out at the Ordinary Meeting of Shareholders on October 25, 1934, and the procedure of succession was finished on March 15, 1935.

High Voltage Transmission Lines

SUPPLEMENT :—

Ujigawa Electric Power Company has a substantial holding in the stocks of the Ohmi Railway Company (a total amount of Y.1,500,000 in capital) which conducts a railway service running a distance of 26 miles between the Hikone and Kibukawa Stations of the Government Railway and also a branch line to the Taga Shrine, one of the most famous old shrines in Japan.

The work of extending the line to Maibara Railway Station has lately been completed and this, together with the plan of another large extension of the line, will bring additional prosperity to the Company.

The Company has now developed to an extent where the area to which it supplies light and power is 1,900 square miles, comprising seven cities (Osaka, Kyoto and Kobe included) and 241 towns.

By virtue of the splendid natural source from which its intake of water is derived, and through power generated in Yamato and also through power purchased from other companies, the Company is favored with unique facilities for the satisfaction of its patrons.

Installation of Generating Power, Output and Purchased Power

The first hydro-electric installation and other hydro-electric or steam power plants are as follows:

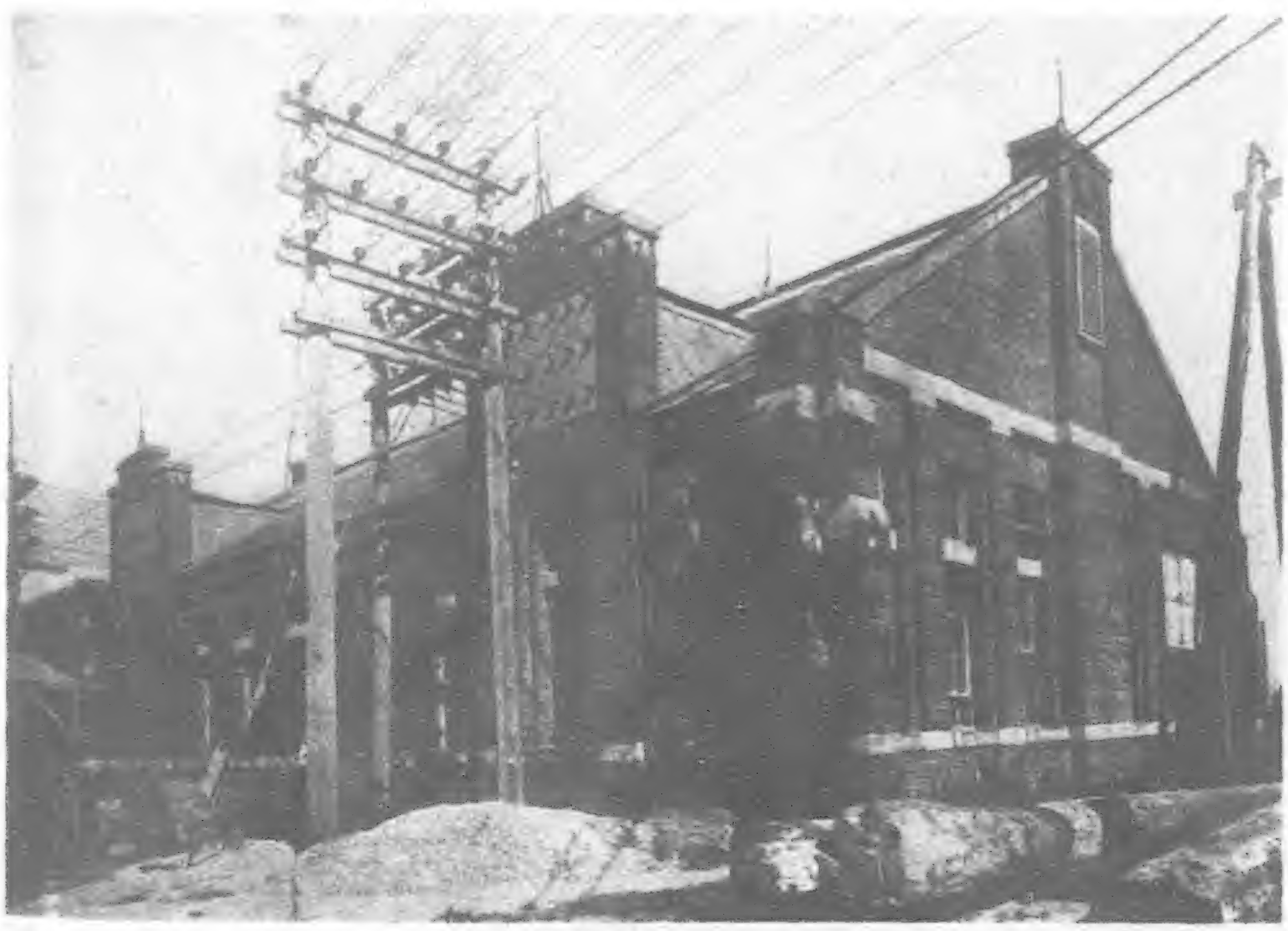
TOTAL GENERATING POWER
(as of September, 1935)

	Erected kw.	*Under Construction kw.*	*Planned kw.*	*Total kw.*
Hydro-electric power ..	97,743	15,756	18,954	132,453
Steam power ..	103,000	—	—	103,000
Total	200,743	15,756	18,954	235,453

Itemized

(1) HYDRAULIC POWER

Name of P.H.	Name of River	Output kw.	Remarks
The Uji Power House	The Ujigawa, Kyoto Prefecture	32,000	Erected
The Shizugawa Power House	The Ujigawa, Kyoto Prefecture	28,000	,,
Ohmine Power House	The Ujigawa, Kyoto Prefecture	16,000	,,
Suriko Power House	The Kitayamagawa, Nara Prefecture	7,740	,,
Shirakawa Power House	The Shirakawa, Nara Prefecture	2,414	,,
Kashio Power House	The Yoshinogawa, Nara Prefecture	2,365	,,
Yoshino Power House	The Yoshinogawa, Nara Prefecture	1,661	,,
Kiwada Power House	The Echigawa, Shiga Prefecture	1,402	,,
Takatokigawa Power House	The Takatokigawa, Shiga Prefecture	1,039	,,
Koizumi Power House	The Anegawa, Shiga Prefecture	966	,,
Aitani Power House	The Echigawa, Shiga Prefecture	747	,,
Tenkawa Power House	The Dorogawa, Nara Prefecture	640	,,
Kayao Power House	The Echigawa, Shiga Prefecture	640	,,
Sako Power House	The Takaharagawa, Nara Prefecture	640	,,
Anegawa Power House	The Anegawa, Shiga Prefecture	615	,,
Takata Power House	The Takatagawa, Wakayama Prefecture	322	,,
Takimoto Power House	The Takimotogawa, Wakayama Prefecture	265	,,
Nachi Power House	The Nachigawa, Wakayama Prefecture	120	,,
Osato Power House	The Ainodanigawa, Mie Prefecture	100	,,
Funada Power House	The Yudanigawa, Mie Prefecture	50	,,
Kusanogawa Power House	The Kusanogawa, Shiga Prefecture	17	,,
Nagatono Power House	The Tennokawa, Nara Prefecture	15,000	Under construction
Ikenogo Power House	The Ikenogogawa, Nara Prefecture	756	,,
Tozugawa Power House	The Tozugawa, Nara Prefecture	8,315	Not yet started
Ohhira Power House	The Ujigawa, Kyoto Prefecture	5,420	,,
Ibuki Power House	The Anegawa, Shiga Prefecture	3,027	,,
Tadehata Power House	The Kanzakigawa, Shiga Prefecture	1,750	,,
Takataki Power House	The Onogawa, Nara Prefecture	442	,,
		132,453 kw.	



Nishinoda Sub-station

A permit for 26,438 kw. water rights in addition to the above, has been applied for.

(2) STEAM POWER

Name of P.H.	Name of Place	Output kw.	Remarks
Kizugawa Power House	Shibatani-cho, City of Osaka	63,000	Erected
Fukuzaki Power House	Fukuzaki-cho, City of Osaka	40,000	,,
		103,000 kw.	

Hydro-Electric Power House

(A) ALONG THE UJI RIVER

(1) THE UJI POWER HOUSE

(First Hydro-Electric Venture)

Location	Ujigo, town of Uji, Kyoto Prefecture.
Intake	Ishiyama-nango-cho, City of Otsu, Shiga Prefecture.
Distance of water-way	36,786-ft.
Quantity of water utilized	2,200 cubic feet per second.
Head	204 feet.
Output	32,000 kw.
Water turbine	6—9,100 h.p.
Generator	6—7,500 kva.
Transformer	7—7,500 kva.
Started	December, 1908 (the 41st year of Meiji).
Completed	July, 1913 (the 2nd year of Taisho).

(2) THE SHIZUGAWA POWER HOUSE

(Second Hydro-Electric Venture)

Location	Makinoosan, Makinoshima-mura, County of Kuse, Kyoto Prefecture (12 cho up the Uji Power House).
Intake	The right side of over 3¼ miles up the Uji Bridge.
Distance of water-way	6,084 feet (the tunnel is 20 feet in width and height).
Dam	216 feet in length, 101 feet in height, 28 feet in depth (upper part).
Distance of back water	3½ miles.
Area of pondage	95 acres.
Maximum water depth	86 feet.
Quantity of back water	129,000,000 cubic feet.
Extent of head tank	19,080 sq. ft.
Ditto depth	24 feet.
Penstock	3—11 feet diameter and 612 feet in length.
Quantity of water utilized	2,800 cubic feet per second.
Head	150 feet.
Output	28,000 kw.
Water turbine	3—17,000 h.p.
Generator	3—14,000 kva.
Transformer	18—3,000 kva.
Started	September, 1920.
Completed	March, 1924.

(3) THE OHMINE POWER HOUSE

(Fourth Hydro-Electric Venture)

Location	Takao, Tahara-mura, County of Tsuzuki, Kyoto Prefecture.
Intake	do.
Distance of water-way	546 feet.
Quantity of water utilized	3,500 cubic feet per second.
Head	70 feet.
Output	16,000 kw.
Water turbine	2—12,500 h.p.
Generator	2—10,000 kva.
Started	October, 1923.
Completed	August, 1926.

(B) OHMI BRANCH

(1) KAYAO POWER HOUSE

Location	Yamagami-mura, County of Kanzaki, Shiga Prefecture.
Intake	do.
Distance of water-way	9,552 feet.
Quantity of water utilized	80 cubic feet per second.
Head	137 feet.
Output	640 kw.
Water turbine	1—950 h.p.
Generator	1—800 kva.
Completed	February, 1911.

(2) ANEGAWA POWER HOUSE

Location	Higashi Kusano-mura, County of Higashi Asai, Shiga Prefecture.
Intake	do.

Shizugawa Power Plant

Distance of water-way	17,268 feet.
Quantity of water utilized	35 cubic feet per second.
Head	320 feet.
Output	615 kw.
Water turbine	1—1,100 h.p.
Generator	1—720 kva.
Completed	December, 1915.

(3) AITANI POWER HOUSE

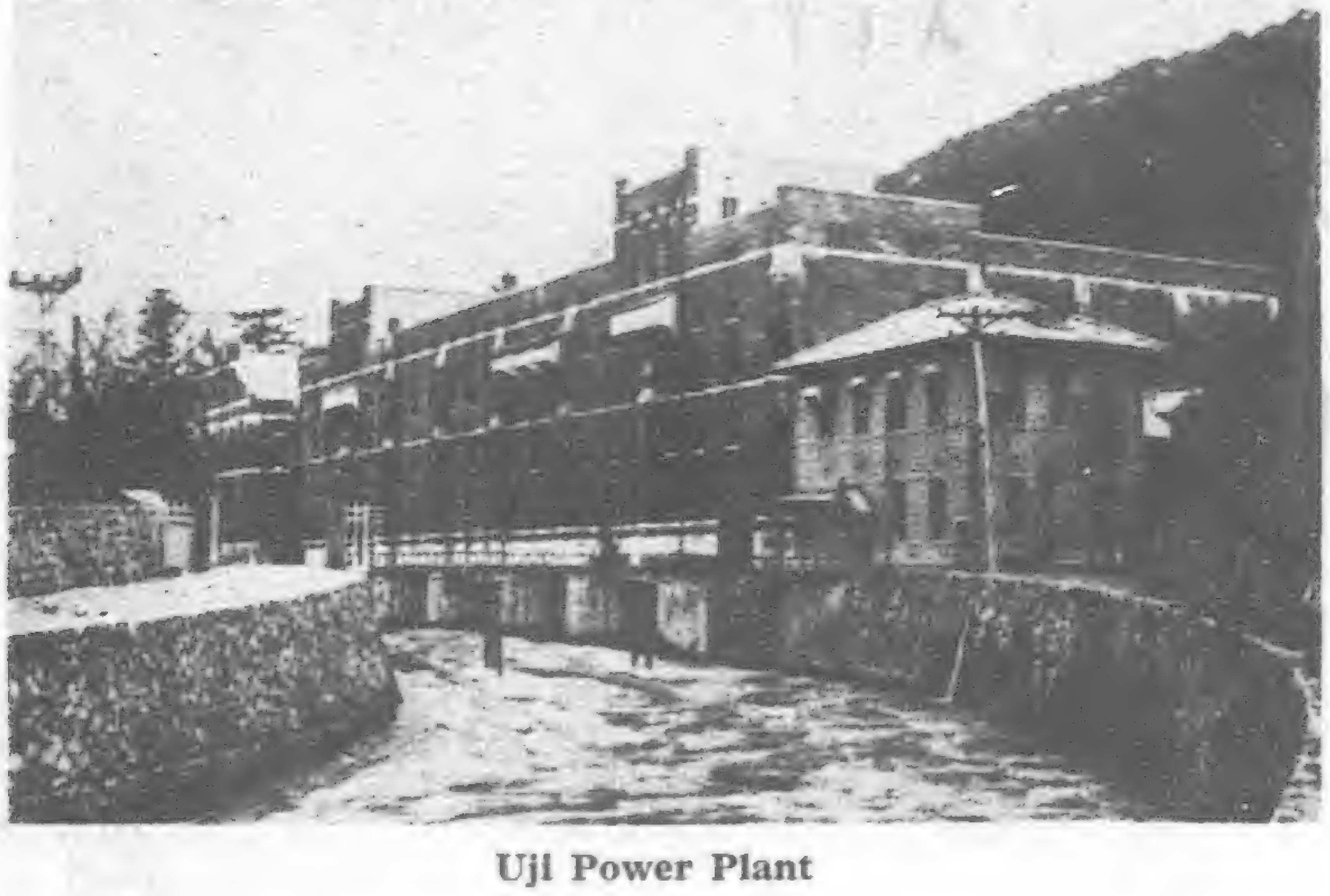
Location	Yamagami-mura, County of Kanzaki, Shiga Prefecture.
Intake	do.
Distance of water-way	12,612 feet.
Quantity of water utilized	100 cubic feet per second.
Head	116 feet.
Output	747 kw.
Water turbine	1—1,250 h.p.
Generator	1—750 kva.
Completed	August, 1919.

(4) KIWADA POWER HOUSE

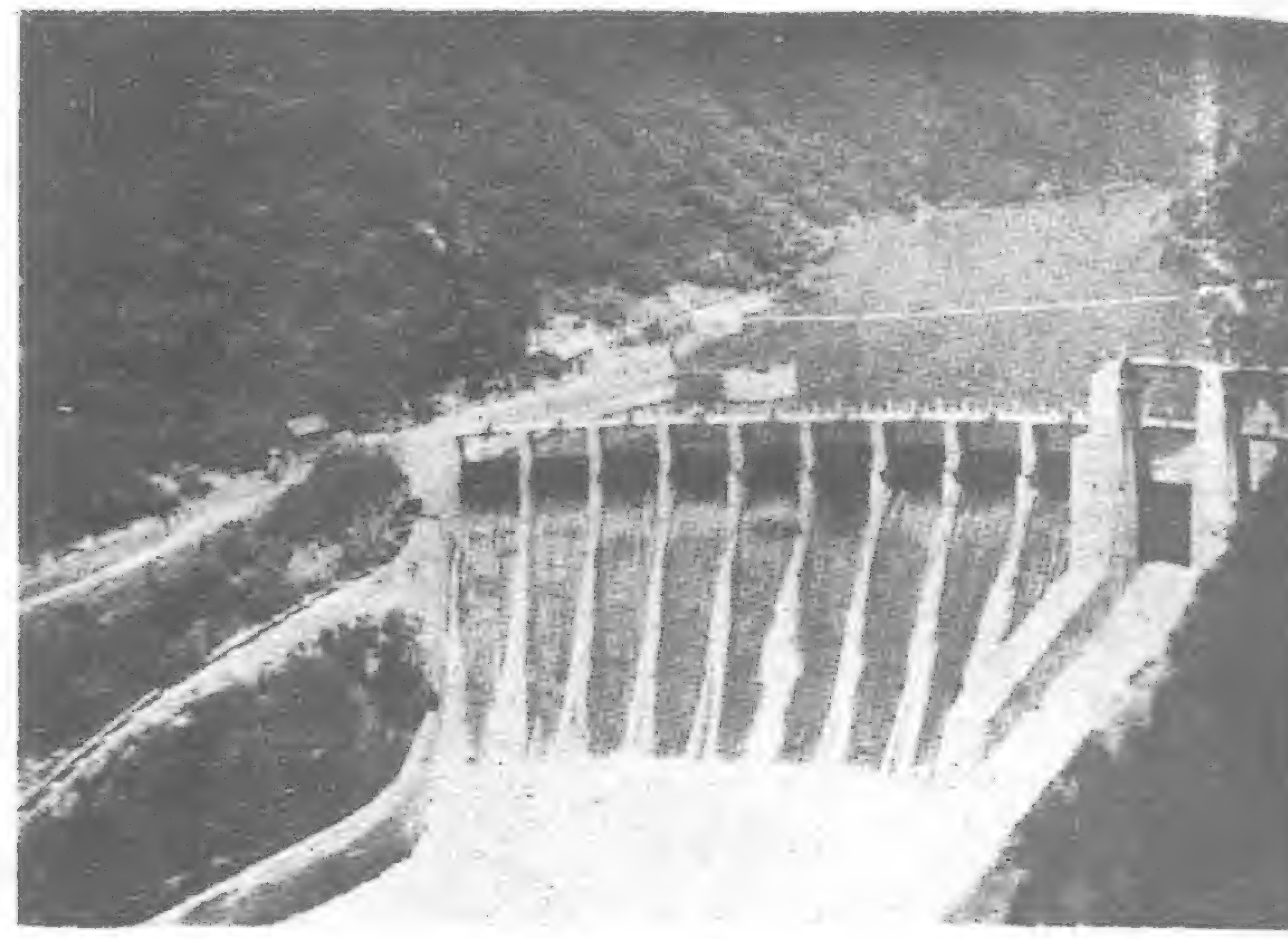
Location	Higashi Komuku-mura, County of Echi, Shiga Prefecture.
Intake	do.
Distance of water-way	12,930 feet.
Quantity of water utilized	67 cubic feet per second.
Head	321 feet.
Output	1,402 kw.
Water turbine	2—1,100 h.p.
Generator	1—750 kva. 1—720 kva.
Completed	April, 1922.

(5) TAKATOKIGAWA POWER HOUSE

Location	Takatoki-mura, County of Ika, Shiga Prefecture.
Intake	do.
Distance of water-way	8,286 feet.
Quantity of water utilized	200 cubic feet per second.
Head	81 feet.
Output	1,039 kw.
Water turbine	2—825 h.p.
Generator	1—1,350 kva.
Completed	October, 1925.



Uji Power Plant



Shizugawa Dam

(6) KOIZUMI POWER HOUSE

Location	Ibuki-mura, County of Sakata, Shiga Prefecture.
Intake	do.
Distance of water-way	4,374 feet.
Quantity of water utilized	160 cubic feet per second.
Head	93 feet.
Output	966 kw.
Water turbine	2—780 h.p.
Generator	2—650 kva.
Completed	June, 1931.

Kusanogowa Power House (17.4 kilowatts) omitted.

(C) YAMATO BRANCH

(1) SAKO POWER HOUSE

Location	Kawakami-mura, County of Yoshino, Nara Prefecture.
Intake	do.
Distance of water-way	6,348 feet.
Quantity of water utilized	13 cubic feet per second.
Head	727 feet.
Output	640 kw.
Water turbine	2—600 h.p.
Generator	2—400 kva.
Completed	August, 1912.

(2) TENKAWA POWER HOUSE

Location	Tenkawa-mura, County of Yoshino, Nara Prefecture.
Intake	do.
Distance of water-way	846 feet.
Quantity of water utilized	18 cubic feet per second.
Head	548 feet.
Output	640 kw.
Water turbine	1—1,000 h.p.
Generator	1—800 kva.
Completed	January, 1915.

Nagasone Sub-station

Spillway Dam at Nango

(3) SHIRAKAWA POWER HOUSE

Location	Kami Kitayama-mura, County of Yoshino, Nara Prefecture.
Intake	do.
Distance of water-way	12,168 feet.
Quantity of water utilized	60 cubic feet per second.
Head	602 feet.
Output	2,414 kw.
Water turbine	2—2,200 h.p.
Generator	2—1,900 kva.
Completed	October, 1921.

(4) YOSHINO POWER HOUSE

Location	Nakanosho-mura, County of Yoshino, Nara Prefecture.
Intake	do.
Distance of water-way	15,138 feet.
Quantity of water utilized	350 cubic feet per second.
Head	78 feet.
Output	1,661 kw.
Water turbine	3—1,100 h.p.
Generator	3—1,000 kva.
Completed	September, 1922.

(5) KASHIO POWER HOUSE

Location	Nakanosho-mura, County of Yoshino, Nara Prefecture.
Intake	Kawakami-mura, County of Yoshino, Nara Prefecture.
Distance of water-way	9,480 feet.
Quantity of water utilized	220 cubic feet per second.
Head	176 feet.
Output	2,365 kw.
Water turbine	3—1,800 h.p.
Generator	3—1,250 kva.
Completed	April, 1923.

(6) SURIKO POWER HOUSE

Location	Shimokitayama-mura,County of Yoshino, Nara Prefecture.
Intake	do.
Distance of water-way	9,906 feet.
Quantity of water utilized	690 cubic feet per second.
Head	185 feet.
Output	7,740 kw.
Water turbine	3—4,000 h.p.
Generator	3—3,300 kva.
Completed	January, 1932

(D) KUMANO BRANCH

(1) NACHI POWER HOUSE

Location	Nachi-mura, Country of Higashimuro, Wakayama Prefecture.
Intake	do.
Distance of water-way	4,326 feet.
Quantity of water utilized	10.5 cubic feet per second.
Head	287 feet.
Output	120 kw.
Water turbine	1—250 h.p.
Generator	1—150 kva.
Completed	January, 1913.

(2) TAKATA POWER HOUSE

Location	Takata-mura, County of Higashimuro, Wakayama Prefecture.
Intake	do.
Distance of water-way	4,518 feet.
Quantity of water utilized.	10 cubic feet per second.
Head	555 feet.
Output	322 kw.
Water turbine	1—200 h.p. 1—300 h.p.
Generator	1—140 kva. 1—240 kva.
Completed	September, 1919.

(3) TAKIMOTO POWER HOUSE

Location	Koguchi-mura, County of Higashimuro, Wakayama Prefecture.
Intake	do.
Distance of water-way	8,730 feet.
Quantity of water utilized	6 cubic feet per second.
Head	687 feet.
Output	265 kw.
Water turbine	1—375 h.p.
Generator	1—300 kva.
Completed	December, 1921.

Osato Power House (100 kilowatts) and Funada Power House (50 kilowatts) omitted.

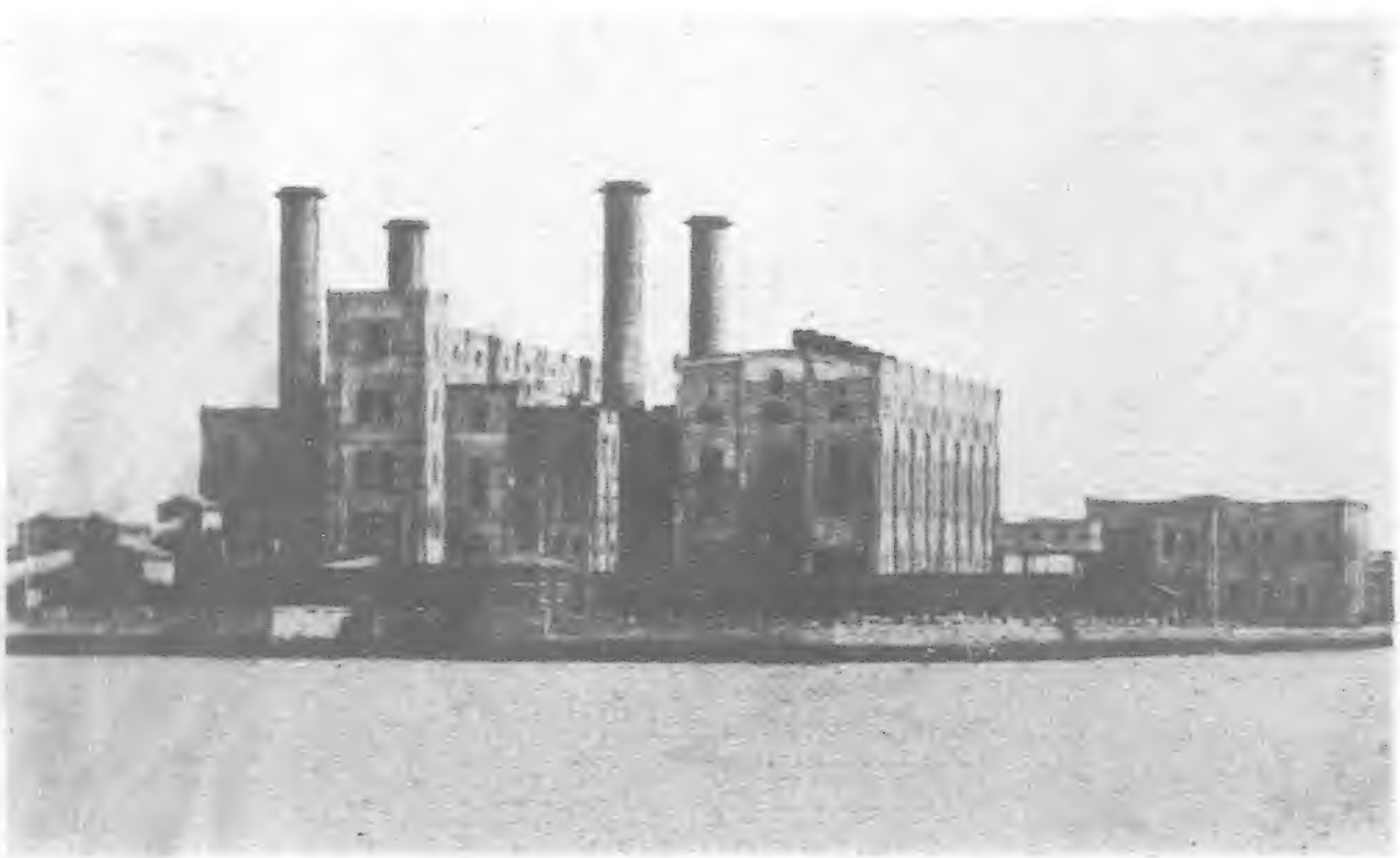
Steam Power House

(1) FUKUZAKI POWER HOUSE

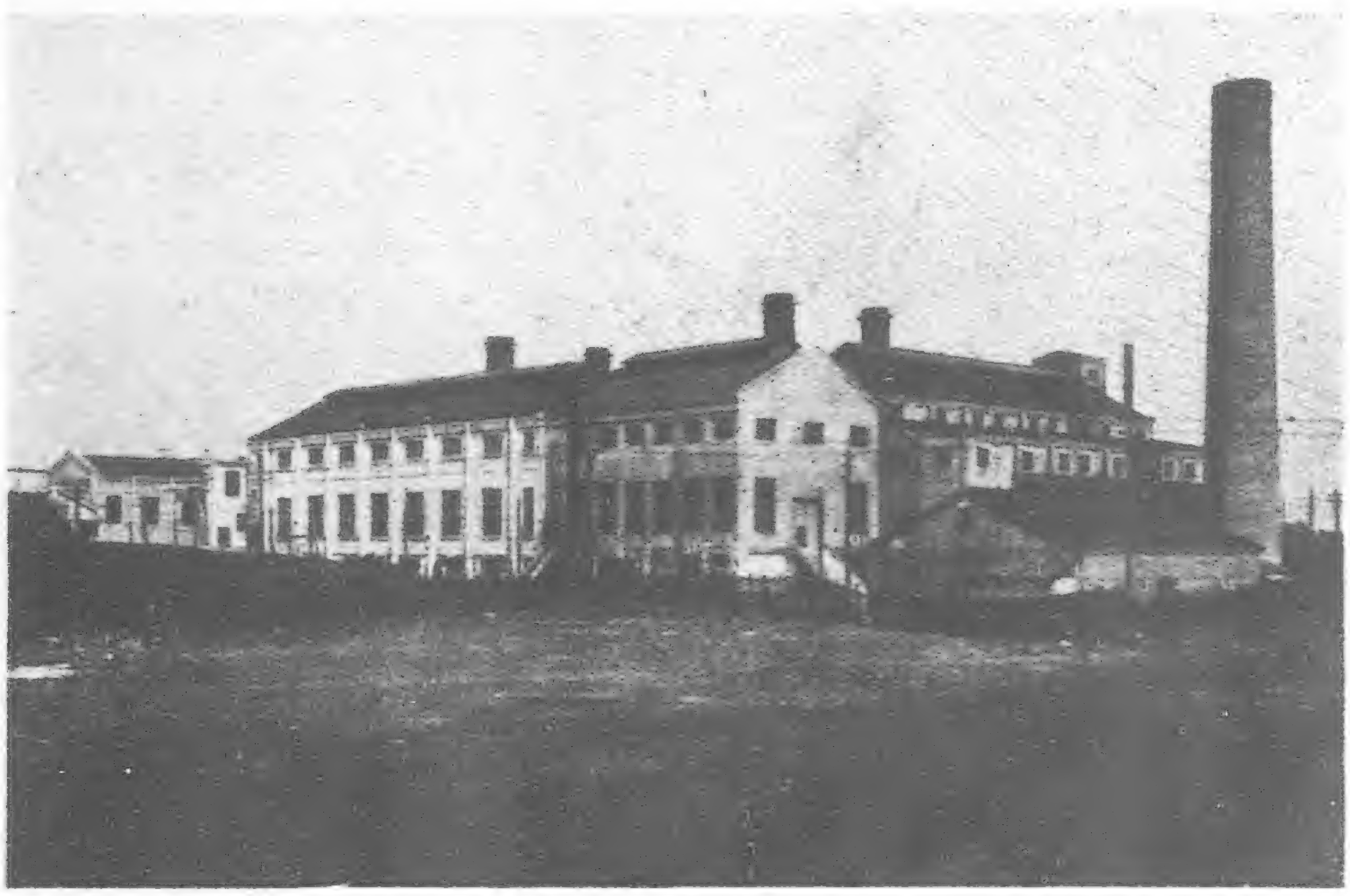
Location	Kita Fukuzaki Higashino-cho, Minato-ku, the City of Osaka.
Output	40,000 kw.
Boiler	13—7,097 sq. ft. (Heating surface). 1—8,615 sq. ft. (Heating surface).
Steam pressure	250 lb. per square inch.
Degree of superheat	225°F
Stoker	13—underfeed stoker and 1-pulverized coal equipment.
Economizer	13—4,915 sq. ft. (H.S.) 1—5,705 sq. ft.
Stack	5—Reinforced concrete.
Steam turbine	4—16,750 h.p.
Condenser	4—16,000 sq. ft. (C.S.)
Generator	4—12,500 kva.
Coal handling	Pier built at the Shirinashi River for ships under 350 tons.
Completed	April, 1923 (the 12th year of Taisho).

(2) KIZUGAWA POWER HOUSE

Location	Shibatani-cho, Sumiyoshi-ku, the City of Osaka.
Output	63,000 kw.
Boiler	8—15,319 sq. ft. (Heating surface).
Steam pressure	375 lb.
Degree of superheat	250°F



Kizugawa Power Plant



Fukuzaki Power Plant

Stoker	8—underfeed stoker.
Economizer	16—4,350 sq. ft. (H.S.)
Stack	4—steel plate.
Steam turbine	2—44,000 h.p.
Condenser	2—38,700 sq. ft. (C.S.)
Generator	2—2,140 kva.
Coal handling	70 tons per hour.
Completed	October, 1927 (the 2nd year of Showa).

Hydro-Electric Power House

(Under construction or permission applied for)

(A) ALONG THE UJI RIVER

(1) The Third Hydro-Electric Venture

Ohhira Power House

(Permission applied for)

Location	Ishiyama-Sotohata-cho, City of Otsu, Shiga Prefecture.
Intake	Ishiyama-Nango-cho, City of Otsu, Shiga Prefecture.
Distance of water-way	13,518 feet.
Quantity of water utilized	1,800 cubic feet per second.
Head	48 feet.
Output	5,420 kw.
Water turbine	3—4,000 h.p.
Generator	3—3,500 kva.

(B) OHMI BRANCH

(1) Ibuki Power House

(Permission applied for)

Location	Ibuki-mura, County of Sakata, Shiga Prefecture.
Intake	Higashi Kusano-mura, County of Asai, Shiga Prefecture.
Distance of water-way	31,548 feet.
Quantity of water utilized	90 cubic feet per second.
Head	527 feet.
Output	3,027 kw.

(2) Tadehata Power House

(Permission applied for)

Location	Yamagami-mura, County of Kanzaki, Shiga Prefecture.
Intake	do.
Distance of water-way	14,874 feet.
Quantity of water utilized	60 cubic feet per second.
Head	542 feet.
Output	1,750 kw.

Another four power houses with total capacity of 15,875 kilowatts (water right permission applied for) omitted.

(C) YAMATO BRANCH

(1) Nagatono Power House

(under construction)

Location	Tozugawa-mura, County of Yoshino, Nara Prefecture.
Intake	Oto / Tenkawa } mura, County of Yoshino, Nara Prefecture.
Distance of water-way	32,340 feet.
Quantity of water utilized	342 cubic feet per second.
Head	647 feet.
Output	15,000 kw.

(2) Ikenogo Power House

(under construction)

Location	Shimokitayama-mura, County of Yoshino, Nara Prefecture.
Distance of water-way	3,852 feet.
Quantity of water utilized	30 cubic feet per second.
Head	417.5 feet.
Output	756 kw.

(3) Tozugawa Power House

(not yet started)

Location	Tozugawa-mura, County of Yoshino, Nara Prefecture.
Intake	do
Distance of water-way	24,704 feet.
Quantity of water utilized	1,760 cubic feet per second.
Head	215 feet.
Output	8,315 kw.

(4) Takataki Power House

(not yet started)

Location	Tozugawa-mura, County of Yoshino, Nara Prefecture.
Distance of water-way	6,840 feet.
Quantity of water utilized	14 cubic feet per second.
Head	598 feet.
Output	442 kw.

Another five power houses with total capacity of 9,867 kilowatts (water right permission applied for) omitted.

(D) KUMANO BRANCH

One power house (water right permission applied for) of 696 kilowatts capacity omitted.

The Company further applied for the water right permission of the following Power Houses, on October 19, 1935.

Tozugawa No. 1 Power House Output 12,400 kw.

Tozugawa No. 2 Power House Output 13,600 kw.

Tozugawa No. 3 Power House (in place of Tozugawa Power House of 8,315 kw. Capacity) Output 27,000 kw.

Power Purchased from Other Companies

Although the Company's output is over 235,453 kilowatts, the supply is still less than the demand, present and prospective. It has, therefore, been obliged to purchase power from other electric power companies, as follows:

(1) From the Ibigawa Electric Power Company.
(2) From the Daido Electric Power Company.
(3) From the Imazu Electric Power Company.
(4) From the Nippon Electric Power Company.
(5) From the Kansai Co-operated Steam Power Company.
(6) From the Kobe City.
(7) From the Shingu Electric Power Company.

Itemized statement of power at present received from the companies:

Supplier	*Power Received kw.*	*Remarks*
The Ibigawa Electric Power Company ..	6,000	Another 4,000 kw. at irregular intervals.
The Daido Electric Power Company ..	123,300	
The Imazu Electric Power Company ..	10,000	
The Nippon Electric Power Company ..	15,500	
The Kansai Co-operated Steam Power Company	33,400	
The Kobe City	3,000	
The Shingu Electric Power Company ..	200	
Total	191,400 kw.	

Instalment of Transmission Distribution and Sub-station

(1) Main Office

A part of the power generated at the Uji Power House is transmitted to the Fushimi Sub-station for the purpose of supplying to the Kyoto Electric Light Company and the Kyoto Municipal Electric Bureau through the Kyoto Sub-station and the remainder is transmitted at a voltage of 55,000 to the Neyagawa Sub-station, near Osaka, and to the Hachiman Sub-station in the Ohmi Branch.

The Power generated by the Shizugawa Power House runs parallel with that from the Ohmine Power House and is transmitted by 55,000-volts to the Neyagawa Sub-station where the same is

connected, through transformers, with the power transmitted by 77,000-volts from the Kizugawa Steam Power House, the power houses of the Yamato Branch of the Company and the Osaka Sub-station of the Daido Electric Power Company. A part of the above is transmitted by 77,000-volts to the Tachibana, Kobe No. 1 and No. 2 Sub-stations, and the remainder, by 55,000-volts to the Mikuni, Noe, Wakae and Nagasone Sub-stations.

Thus the Neyagawa Sub-station is the most important central sub-station where the power is concentrated from many sources, as stated above, to provide a remarkable continuity of service.

Noe Sub-station

Steam power is generated at the Fukuzaki and Kizugawa Power Houses, and a part of the same is transmitted by 11,000-volts underground line to the sub-stations in Osaka, the remainder, to the Neyagawa Sub-station through the Nagasone Sub-station.

Besides the power generated at the Company's power stations, it purchases power from the Daido Electric Power Company, the Ibigawa Electric Power Company, the Imazu Electric Power Company, the Nippon Electric Power Company and the Kansai Co-operated Steam Power Company. The Power from the Daido Electric Power Company is received at the Neyagawa, Mikuin Sub-stations of the Company and the Abiko, Tatsumi Sub-stations of the Daido Electric Power Company, the Ibigawa Electric Power Company, at the Ogaki Switching station of the Company, the Imazu Electric Power Company, at the Tachibana Sub-station, the Nippon Electric Power Company, at the Amagasaki, Nakahama Sub-stations, and the Kansai Co-operated Steam Power Company, at the Tachibana Sub-station.

The total number of sub-stations and switching stations is about 50 from which 55,000, 22,000, 11,000 or 3,500-volts are supplied to large consumers, stepping down from 3,500-volts to 230-volts to small consumers.

(2) The Ohmi Branch

Although the generator voltage is 3,500-volts, it is stepped up to 20,000-volts and transmitted to ten neighboring sub-stations and one transformer tower from the power house.

These sub-stations and the transformer tower are interconnected by 20,000-volt transmission lines.

Transmission voltage at 20,000-volts is stepped down to 3,500-volts at these sub-stations and the current is supplied to the consumer at 100-volts for light service, and for power at 200-volts.

Recently the demand for light and power in the Ohmi district has increased to such an extent that the output of the electric plants in that area is insufficient. As a result of this, Shohoji Sub-station was erected and Hachiman Sub-station was extended to receive power from the Ibigawa Electric Power Company and the Uji Power Station respectively and also to transmit it to every sub-station in the branch.

(3) The Yamato Branch

The generated voltage at the hydro-electric power houses (Shirakawa, Sako and Tenkawa) is 3,500-volts, but the power is transmitted to all the sub-stations in the district under this branch by 16,500 or 33,000-volt lines, where it is stepped down to 3,500-volts and again stepped down to supply the consumer with 100-volts for electric light and 200-volts for power.

Power generated by the Shirakawa Power House is partly transmitted to the Suriko Power House by 77,000-volt lines, where it is stepped down to 22,000-volts and transmitted in parallel with the power generated at the Suriko Power House to the Shingu, Kinomoto Sub-stations of the Kumano Branch.

Power generated by the Yoshino and Kashio Power Houses is transmitted to the Shinjo Sub-station by 33,000-volt lines, where it is stepped up to 77,000-volts and transmitted together with the power generated at the Suriko Power House to the Neyawawa Sub-station.

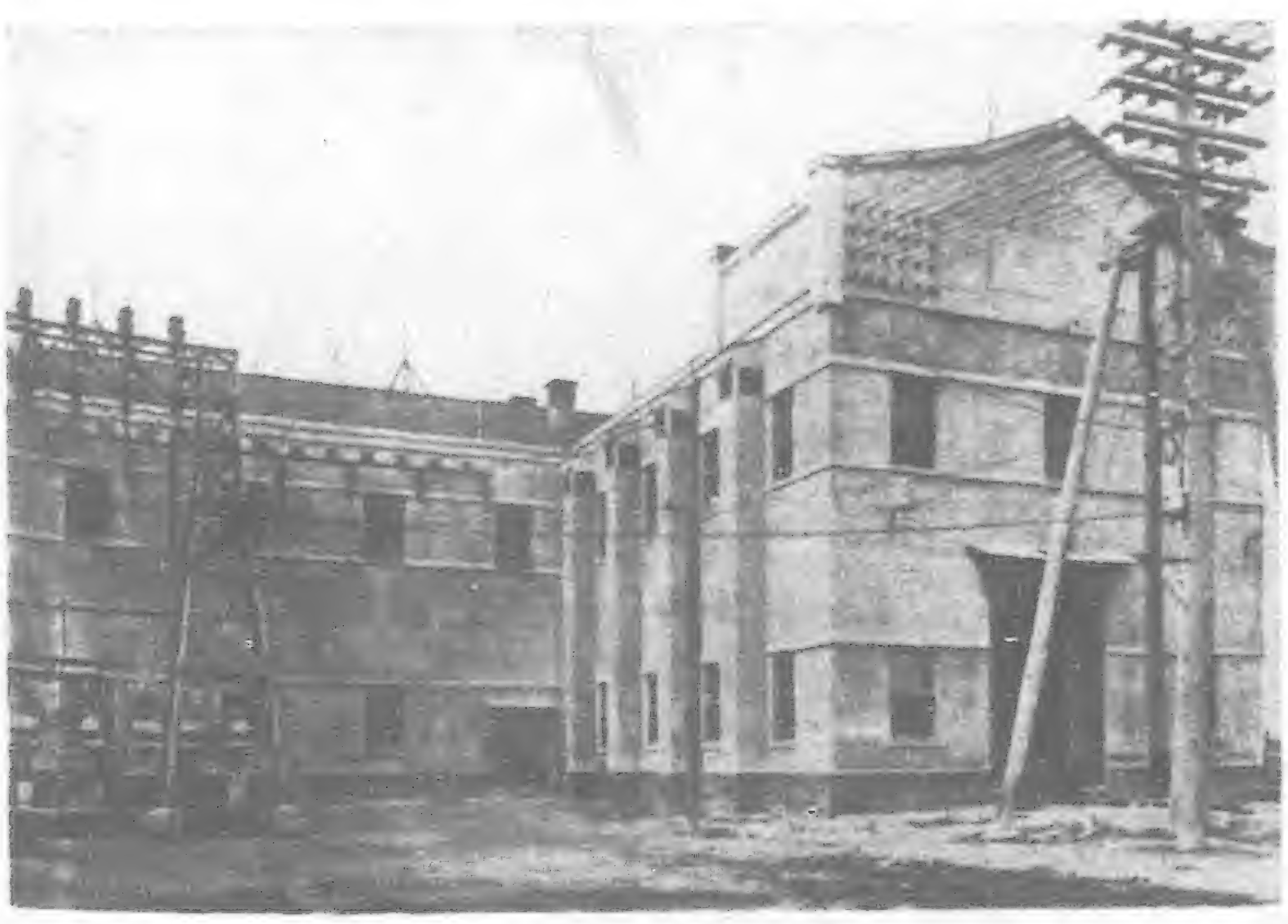
(4) The Kumano Branch

Power generated by all the power houses in this branch is distributed direct from the power houses, but the transmission lines connecting Takimoto, Nachi Power Houses and Katsuura, Nishimukai, Shingu Sub-stations are of 11,000-volt. The Kinomoto and Shingu Sub-stations get power from the Yamato Branch. In addition, the Shingu Sub-station is equipped to receive 700 kilowatts steam power from the Shingu Electric Power Company. Voltage supplied to the consumer coming under the Kumano Branch is 100-volts for electric light and 200-volts for power.

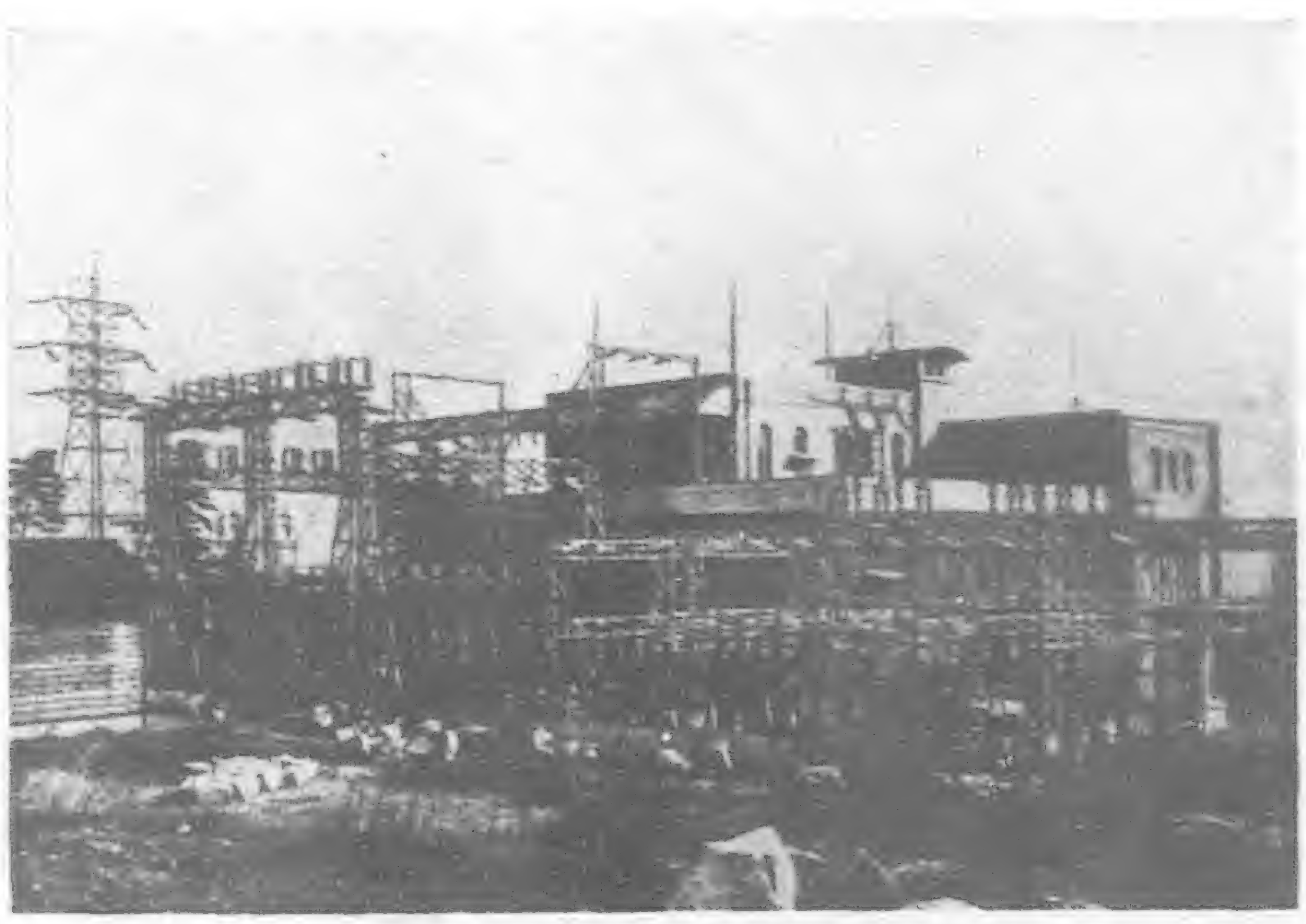
(5) Sub-station (as of September, 1935).

(No. of frequency of the alternating current served by the Company is 60 cycles, without any distinction as to main office or branches).

Jurisdiction	*Name*	*kva. capacity granted*	*Location*
Main Office	Noe Sub-station	42,000	Noe-cho, Asahi-ku, the City of Osaka.
,,	Mikuni Sub-station	69,000	Mikunihom-machi, Higashi-yodogawa-ku, the City of Osaka.
,,	Tachibana Sub-station	32,000	Kitananiwa-cho, the City of Amagasaki
,,	Nagasone Sub-station	18,000	Kanaoka-mura, Kawachi, Osaka Prefecture.



Tachibana Sub-station



Kobe No. 1 Sub-station

Jurisdiction	*Name*	*kva. capacity granted*	*Location*
Main Office	Urae Sub-station	18,000	Urae-cho, Nishiyodogawa-ku, the City of Osaka.
,,	Kobe No. 1. Sub-station	54,000	Gomo-dori, Nada-ku, the City of Kobe.
,,	Fushimi Sub-station	18,000	Yokooji-cho, Fushimi-ku, the City of Kyoto.
,,	Neyagawa Sub-station	30,000	Neyagawa-mura, Kawachi, Osaka Prefecture.
,,	Kobe No. 2 Sub-station	36,000	Maeda, Myohoji, the City of Kobe.

Besides the above, there are 34 Sub-stations and also 13 switching stations.

Ohmi Branch	Hachiman Sub-station	17,460	Hachiman-cho, Gamao-gun, Shiga Prefecture.
,,	Shohoji Sub-station	5,400	Sembon-mura, Inukami-gun, Shiga Prefecture.

Besides these, nine distributing sub-stations and transformer towers are granted.

Yamato Branch	Shinjo Sub-station	4,500	Shinjo-cho, Kitakatsuragi-gun, Nara Prefecture.
,,	Gose Sub-station	3,800	Gose-cho, Minamikatsuragi-gun, Nara Prefecture.

Besides these, there are 10 distributing sub-stations, switching stations and transformer-towers.

Kumano Branch	Shingu Sub-station	3,550	Shingu-shi, Wakayama Prefecture.
,,	Kinomoto Sub-station	450	Arii-mura, Minamimuro-gun, Mie Prefecture.
,,	Katsuura Sub-station	450	Nachi-mura, Higashimuro-gun, Wakayama Prefecture.
,,	Nishimukai Sub-station	450	Nishimukai-cho, Higashimuro-gun, Wakayama Prefecture.

Power sold by the Main Office since business commenced, and electric light and power sold by all branches are as follows:

Statement of Power Sold

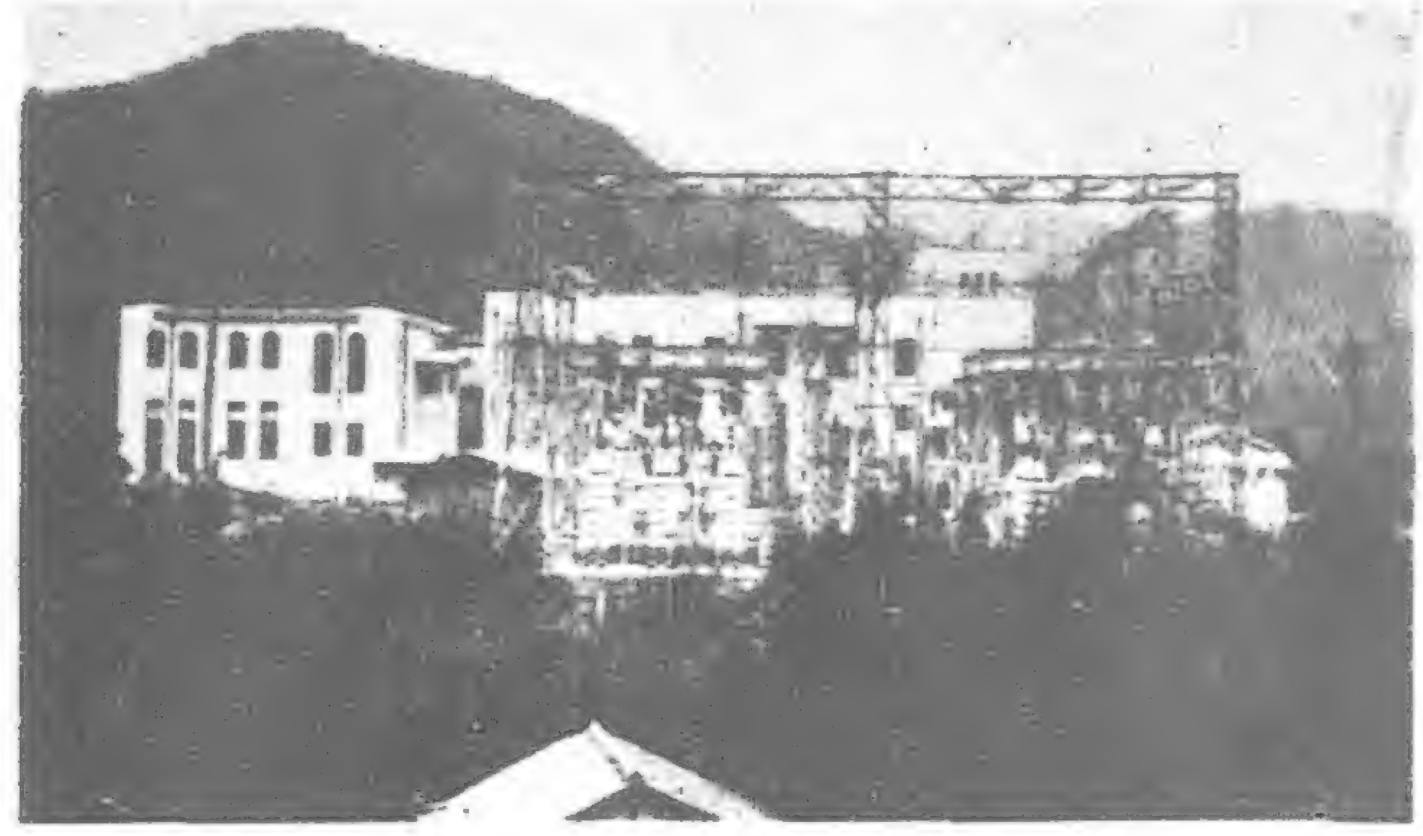
MAIN OFFICE

(Business commenced August 1, 1913).

	Power	*Consumers*
1914	40,276 h.p.	1,476
1915	54,613 ,,	2,151
1916	63,859 ,,	3,011
1917	77,183 ,,	3,794
1918	87,160 ,,	4,784
1919	105,147 ,,	5,693
1920	111,389 ,,	5,879
1921	127,593 ,,	6,627
1922	144,851 ,,	8,318
1923	164,196 ,,	9,753
1924	200,550 ,,	10,993
1925	240,297 ,,	12,444
1926	272,117 ,,	13,691
1927	320,986 ,,	14,895
1928	344,418 ,,	16,569
1929	396,326 ,,	18,226
1930	449,283 ,,	19,929
1931	490,954 ,,	21,459
1932	522,154 ,,	23,475
1933	548,188 ,,	25,954
1934	598,328 ,,	28,097
1935	657,127 ,,	30,638
1935	693,224 ,,	32,322

Koizumi Power Plant

Customers in the Head Office district comprise all well-known companies and firms, among the largest being Messrs. the Osaka City, the Kobe City, the Kyoto City, the Nankai Electric Railway Company, the Osaka Electric Tramway Company, the Kyoto Electric Light Company, the Hanshin Electric Railway Company, the Hanshin Kyuko Electric Railway Company, etc.



Kobe No. 2 Sub-station

CONDENSED STATEMENT OF ALL BRANCHES' BUSINESS

	Power	*Consumers*	*Light*	*Consumers*
1925	17,767 h.p.	1,984	317,044	145,912
1926	18,843 ,,	2,311	329,072	148,280
1927	20,306 ,,	2,912	392,295	166,595
1928	20,787 ,,	3,227	408,722	168,902
1929	24,410 ,,	3,922	423,322	171,537
1930	25,696 ,,	4,384	437,395	173,870
1931	26,365 ,,	4,862	444,866	174,758
1932	26,904 ,,	5,214	454,944	175,803
1933	27,385 ,,	5,610	465,916	176,146
1934	27,292 ,,	5,201	415,091	158,780
1935	28,883 ,,	5,861	436,080	163,706
1935	29,490 ,,	5,635	441,533	164,953

Chronological History

1906—Incorporated with capital of Y.12,500,000 and office in Kyoto City; Tokugoro Nakahashi, Esq., appointed as the President.

1907—Permission obtained for First Hydro-electric Development (i.e. Uji Power Plant of 29,000 kilowatts).

1908—The construction work started.

1913—That completed and business commenced.

1916—Capital increased to Y.25,000,000.

1918—Construction of Fukuzaki Steam Power Plant of 30,000 kilowatts began.
Tokugoro Nakahashi, Esq., retired from his position; Asanosuke Nakagawa, Esq., succeeded.

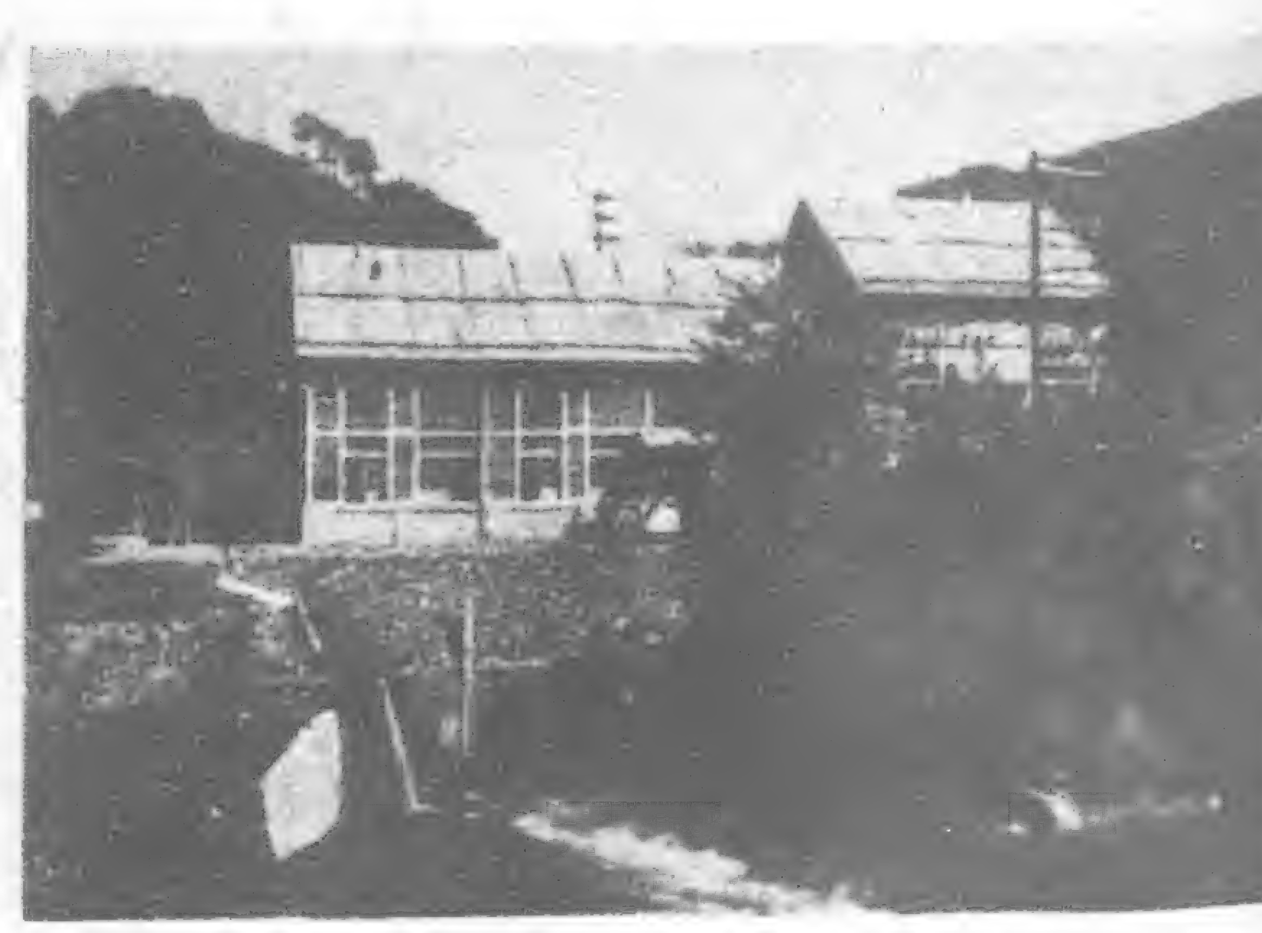
1919—Removal of office to Osaka City.

1920—Fukuzaki Steam Power Plant completed.
Permission received for the Second Hydro-electric Development (i.e. Shizugawa Power Plant of 28,000 kilowatts and the dam),
the work started simultaneously.
Death of Asanosuke Nakagawa, Esq., the President.

1921—Kiyoshi Kimura, Esq., succeeded as the President. Amalgamation of Ohmi Hydro-electric Power Co.; capital increased to Y.31,400,000.
Acquisition of Yamato Electric Power Co.; capital increased to Y.37,650,000.

1922—Merger of Kumano Electric Power Co.; capital raised to Y.38,700,000. Output of Uji Power Plant increased to 32,000 kilowatts.
Acquisition of Taisho Hydro-electric Power Co.: capital increased to Y.41,366,650. Capital raised again to Y.85,000,000.

(Continued on page 372)



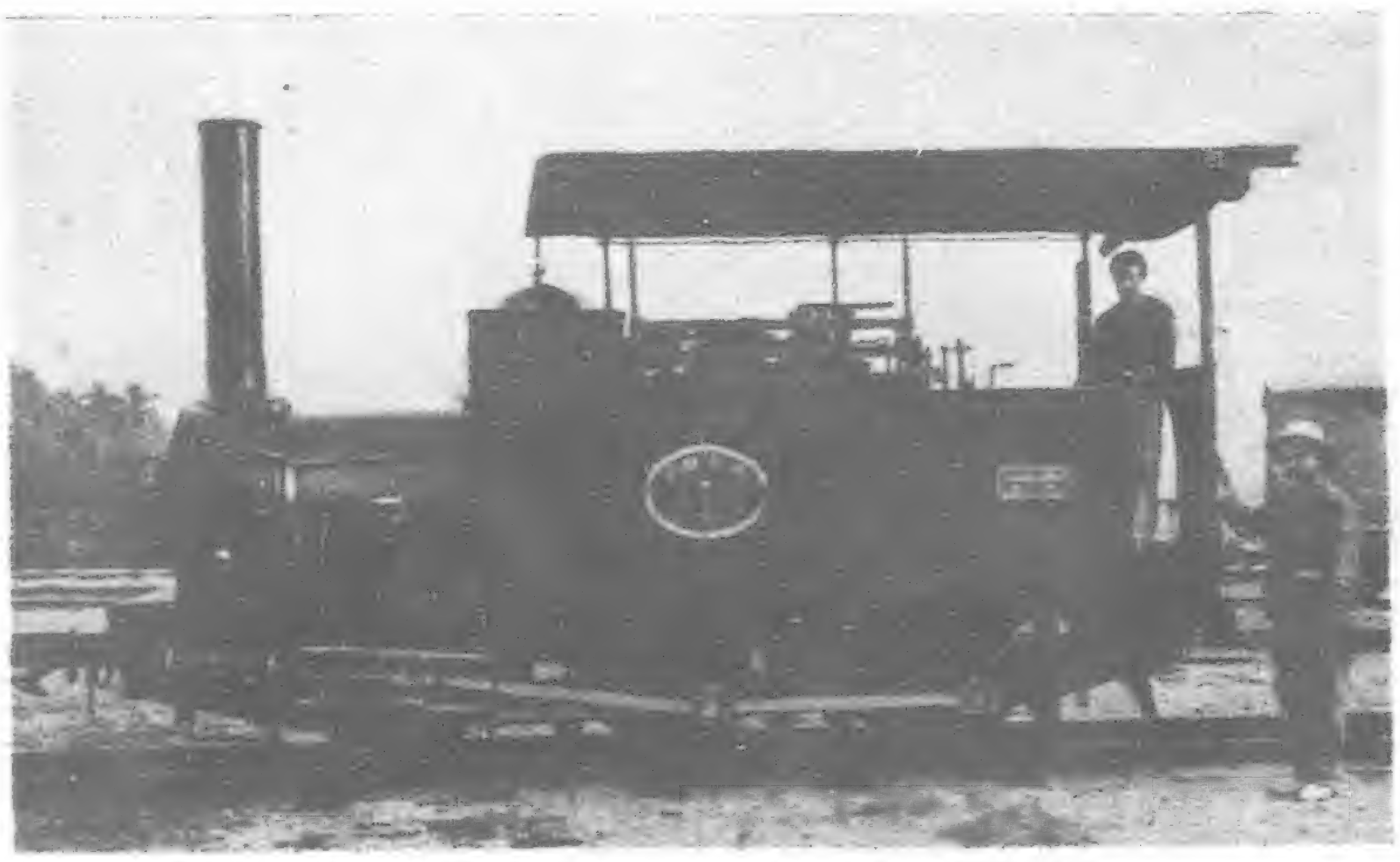
Takatokigawa Power Plant

Locomotives of the Malayan Railways

Past and Present

(This article is the third of a series reviewing the history and progress through a half century of the railways of Malaya and compiled from a record published by the Federated Malay States Railway Administration. The two preceding articles, "Fifty Years of Railways in Malaya" and "Railway Bridges and Railway Buildings in Malaya" appeared in the April, 1936 and July, 1936 numbers of The Far Eastern Review).

ONE of the tasks which confront the officers of a railway, on the amalgamation of smaller concerns, is the consolidation of physical assets. The evolution, out of a heterogeneous collection of locomotives of all shapes and sizes, of a common locomotive policy, will absorb much time, thought and money. Much credit is due to those responsible for the inauguration of railway transport in Malaya, in that the advantages of standardization were realized from the very start. Although a few odd locomotives were at work for many years there was, nevertheless, introduced in 1885 the first standard type engine, which was adopted by both the Perak and Selangor States Railways, as well as by the Singapore Government Railway, and the Malacca Railway in later years. This type, known as the "A" class in F.M.S.R. records, and of which there were 18 engines, was a 4-4-0 tank engine having cylinders 10-in. dia. by 16-in. stroke. The coupled wheels were 3-ft. 3-in. in diameter. The total weight was 20 tons, of which 14 tons 15 cwt. were carried by the coupled wheels.



F.M.S.R. Locomotive—No. 1 built in 1881

In 1890 a rather more powerful engine of the same type was put into service. The cylinders were 12-in. dia. by 18-in. stroke, and the total weight 24 tons. There were seven in all, the last being built as late as 1911.

As route mileage increased, the want of an engine of greater capacity was felt. And here the liaison between the Perak and Selangor Railways appears to have broken down. Perak was content to add a tender to the "B" class, thus increasing the fuel and water capacity. This type, ultimately known as the "C" class, was first introduced in 1893. Seven engines in all were built. In 1894 and 1895 Selangor put to work four 4-6-0 tender engines. This type appeared in F.M.S.R. records as class "D"; had cylinders 14-in. dia. by 20-in. stroke: coupled wheels 3-ft. 3-in. in diameter and a total weight of 42 tons. The tender was carried on four wheels.

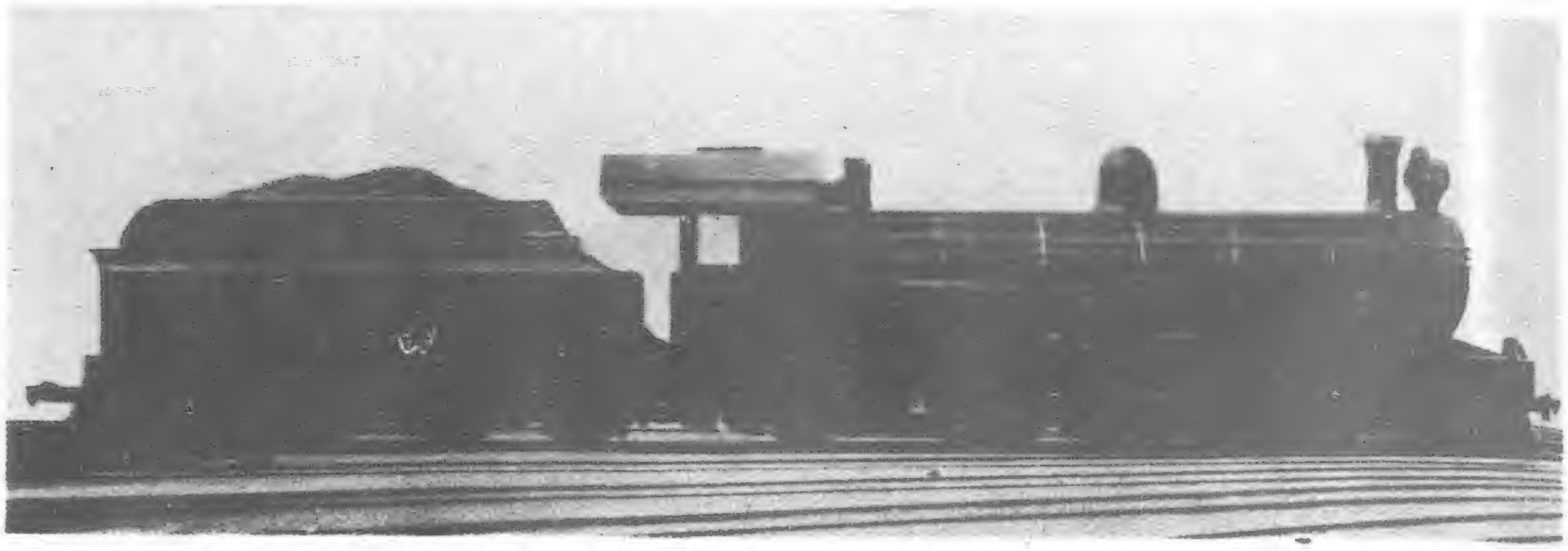
In 1897 Perak retorted with two 4-6-0 ("E" class) engines having cylinders 14½-in. by 20-in. stroke, coupled wheels 4-ft. 3-in. diameter and a total weight, including the four-wheeled tender, of 43 tons. In the same year Selangor bought two 4-4-0 tender engines having cylinders 14-in. dia. by 20-in. stroke and the coupled wheels 4-ft. 3-in. diameter. The total weight was 40 tons.

It is not clear whether this multiplication of designs was due to rivalry or to the effect of the Federation of the States which took place in 1895. As these engines were very similar in detail, it is probable that the young Federal department was experimenting prior to the adoption of a final locomotive policy. The point at issue was the general utility engine versus the more orthodox types of goods and passenger locomotives. Perak and the general utility engine won the day and in 1899 there was introduced what is now known as the "G" class. This was a 4-6-0 type, with cylinders 14½-in. by 20-in., 4-ft. 3-in. driving wheels, and a total weight, including the six-wheeled tender, of 51 tons 15 cwt. The boiler pressure was 160 lb. per sq. in. and the tractive effort at 85 per cent of boiler pressure was 10,390 lb. Thirty-four of these engines were built between 1899 and 1904.

At this juncture it is convenient to place some general points on record. So far as is known the early Perak engines bore numbers, while the Selangor engines had names only, and classifications were not consolidated until after 1901 when individual State management was abandoned and a general manager appointed to supervise the united railway. The Singapore Government

The Locomotive of 1890 with Brake Van and members of the staff

Railway, as has already been mentioned, adopted existing types of locomotives from its opening in 1903 until its absorption by the Federated Malay States Railways in 1912. The Malacca Railway had no separate existence, but it is believed that some of the then standard locomotives were employed in its construction. The Sungei Ujong Railway, constructed in 1891, was absorbed in 1908. With it there were taken over three "J" class engines and one "K" class. The "J" class was originally a 0-6-2 tank engine but was subsequently altered to 4-4-2. The cylinders were 10½-in. dia. by 18-in. stroke and the coupled wheels 2-ft. 9-in. diameter. The total weight was 23 tons 12 cwt. The "K" class engine had a similar wheel arrangement. The cylinders were 12-in. dia. by 18-in. stroke, the total weight 42 tons and the diameter of the coupled wheels 3-ft. 6-in.



"H" Class Locomotive (1907)

The consolidation of the growing system had thus resulted in the adoption of the general utility locomotive, a policy which has never been lost sight of, and is in force to-day.

In 1907 the first Pacific type engine was built. This type, known as the "H" class, was a considerable advance upon the "G" class, both in design and power. The cylinders were 15½-in. dia. by 24-in. stroke and the coupled wheels were 4-ft. 6-in. diameter. The boiler had a wide firebox, as being more suitable for burning firewood, the fuel then in use. The boiler pressure was 180 lb. per sq. in. and the total heating surface was 1,235 sq. ft. The grate area was 18.5 sq. ft. The tender was carried by two four-wheeled bogies and had capacity for 2,000 gallons of water and 315 cub. ft. of fuel space. The engine weighed 75 tons 6 cwt. and the tractive effort was 16,293 lb. at 85 per cent of boiler pressure. The axle load was 9 tons 15 cwt. In the later years the weight was increased to 78 tons, by the adoption of thicker frames.

"G" Class Locomotive introduced in 1899

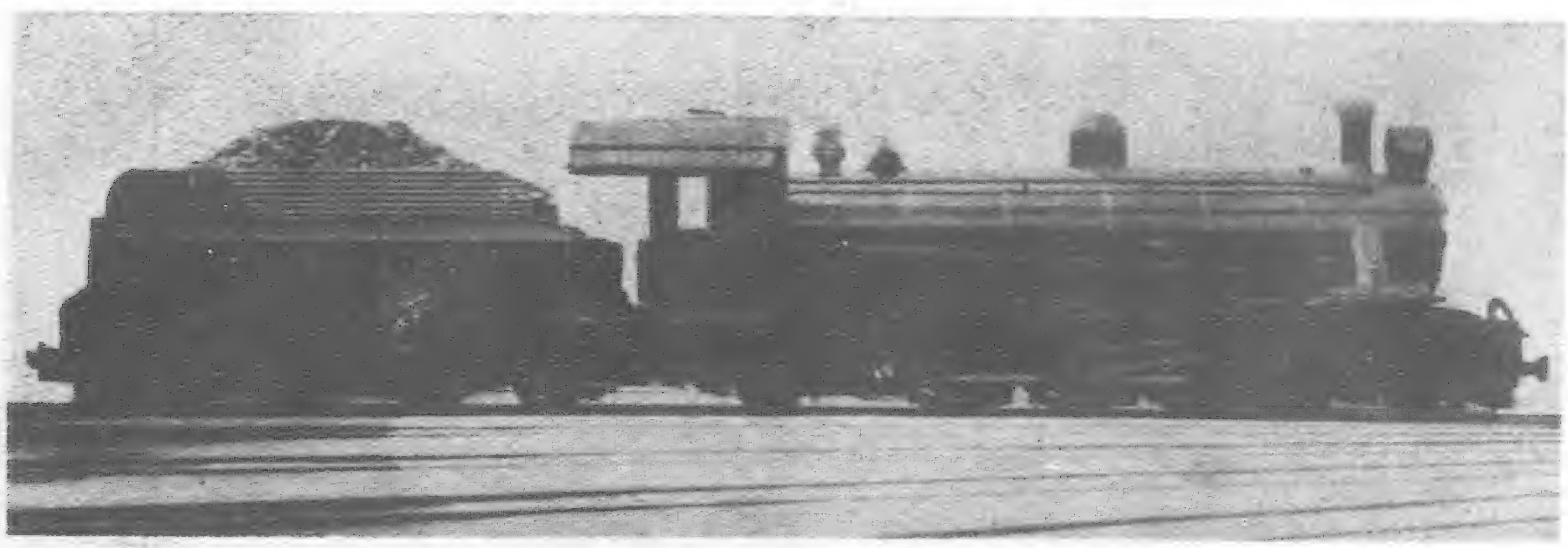
The "I" class followed in 1908. This was a 0-6-4 tank engine, having cylinders 14½-in. by 20-in. and coupled wheels 4-ft. 4-in. diameter. The first eight of these engines had water and fuel capacity of 800 gallons and 90 cub. ft. respectively, but in 1913 a further eight engines were delivered having water capacity increased to 1,200 gallons. The axle load was 10 tons 10 cwt. All subsequent "I" class engines were of the larger type.

Standardization was thus re-established. Apart from the earlier and smaller engines for which work could be found, there were now three types of locomotives; for main line work the "H" class, for short branches, banking and shunting, the "I" class, and for branch line and ballasting the "G" class. Between 1906 and 1914, sixty "H" class engines, and between 1908 and 1916, thirty-five "I" class engines were bought.

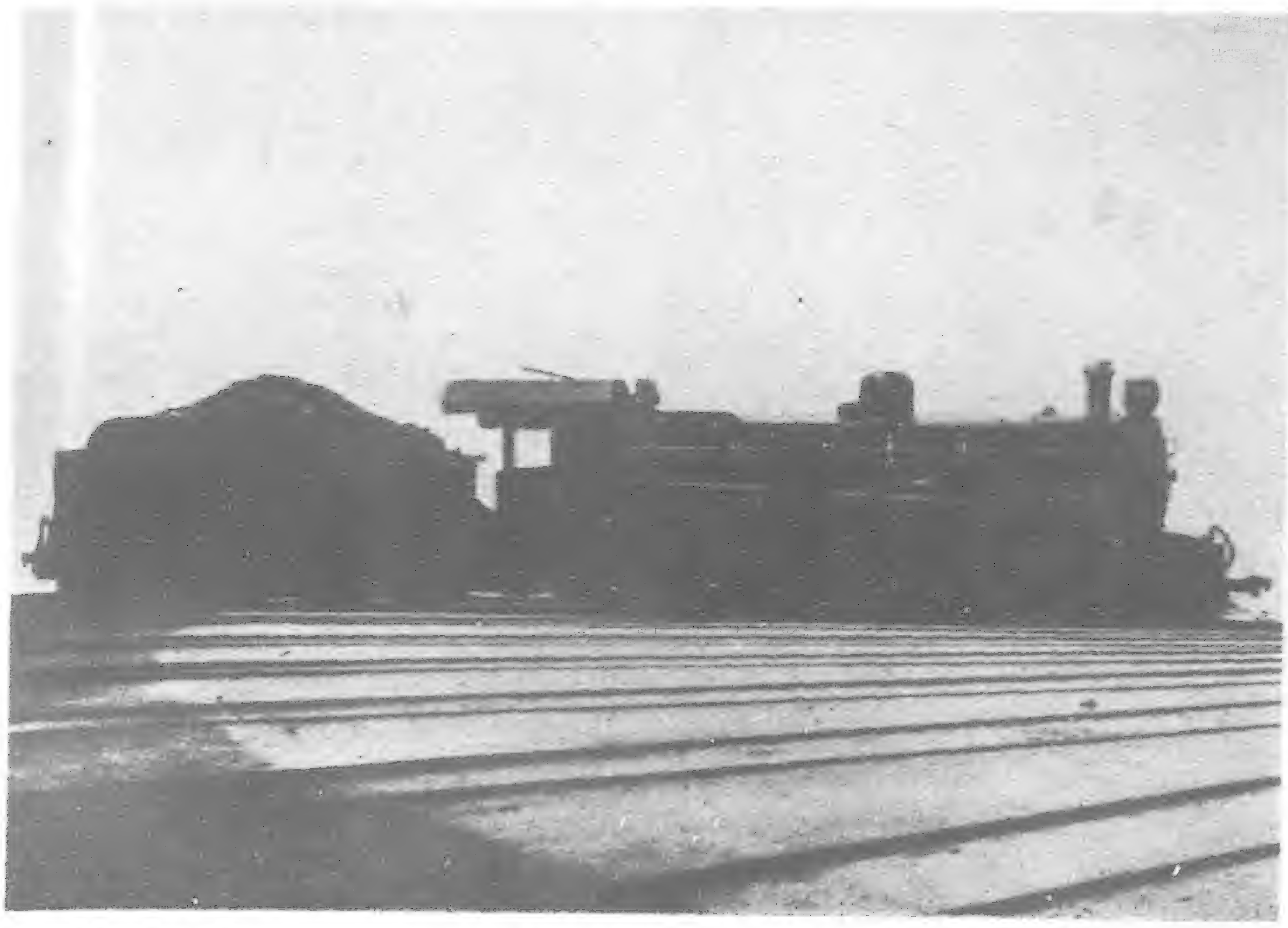
The Johore line, built and financed by the State of Johore, was completed in 1909. Its locomotive stock consisted of 12 engines. Six of these were "H" class engines built in 1908. They were painted a "Caledonian" blue. The remaining six engines, consisting of two "A" class, two "B" class and two "C" class, were purchased from the F.M.S.R. The whole stock were taken over by the F.M.S.R. in 1912, and were given F.M.S.R. numbers and painted the standard colors.

The growth of traffic made it difficult to find locomotives for construction purposes and between the years of 1912 and 1914, twenty secondhand engines (in separate lots of five) were bought from Burma. These were known as the Burma "E" and Burma "O" classes. The former was a 0-4-2 tender engine and the latter a 4-4-0. These engines, although obsolete, gave good service on construction, but the "O" class were found too light for open line use, and only a few were thus employed.

The extensive development by the Great Western Railway of the steam rail car led to the introduction of this principle in Malaya, and in 1914 designs were prepared and the construction locally of nine two-coach sets was commenced. The engine with its vertical boiler was a close imitation of the G.W.R. design, but was carried on a six-wheel bogie. The cylinders were 11-in. dia. by 14-in. stroke. The coupled wheels were 2-ft. 9½-in. diameter. The boiler was pressed to 180 lb. per sq. in., the whole unit developing 7,737 lb tractive effort. The boiler and main frames were purchased from England, but most of the details were manufactured at the



"P" Class Locomotive (1914)



" L " Class Locomotive (1920)

Central workshops. The outbreak of the War, and the difficulty in maintaining existing locomotives in the face of increasing train mileage and decreasing facilities, led to considerable delays in manufacture and eventually to the abandonment of the scheme after four engine units had been completed.

In the meantime, superheated steam had been rapidly developed in England and Europe, and the economies to be effected by its use had been proved beyond doubt. In 1914 orders were placed in England for 20 superheated " H " class engines. The idea of the general utility engine was preserved, but the use of superheated steam necessitated considerable changes on boiler and cylinder design. The principal dimensions of this engine, known as the " P " class, were as follows :

Cyls : 17-in. dia. by 24-in. stroke
Cpld : wheels 4-ft. 6-in. diameter
Bogie wheels 2-ft. 6-in. diameter
Pony and tender wheels 2-ft. 9½-in.
Boiler H.S. total 1,000 sq. ft.
Boiler pressure 160 lb. per sq. in.
Grate area 18.5 sq. ft.
Tender water capacity 2,000 gals.
Fuel 315 cub. ft.
Total weight 78 tons 11 cwt.

It will be noticed that the wheel arrangement and diameters were similar to the " H " class, but the axle loading was increased to 10 tons 10 cwt. At that time locomotive engineers still looked askance at high pressures and it was a common practice to reduce the boiler pressure to counteract the increase in cylinder diameter required for the economic use of superheated steam. In this case the engines were supplied with steam at 160 lb. pressure, but the boilers were constructed to withstand 180 lb. per sq. in. Boiler maintenance had never been a serious problem in Malaya and it was not long before the pressure of the " P " class engines was raised to 180 lb. per sq. in. By this means, and with some reduction in the ratio of adhesion, a rather more powerful locomotive was obtained, the tractive effort of these engines now being 19,645 lb.

Owing to the outbreak of War, the construction of these engines was temporarily suspended. The order was, however, finally completed as a war measure to make room for munitions work in British workshops. Four engines only were delivered to Malaya in 1917, the balance being sent to the Bombay-Baroda and Central India Railway, where the shortage of locomotives was being acutely felt. Sixteen of this class were, however, put in hand on the conclusion of the War and delivered in 1920.

At the conclusion of the War, the Railway was handling a greatly increased volume of traffic with a stock of locomotives inadequate in numbers, and not a little depreciated in condition due to the necessarily restricted facilities for repairs.

In 1918 a number of American built Mallet compounds were offered to the Administration. The engines had a strange history. They were part of an order of 40 engines placed by the Russian Government with Messrs. Baldwin Locomotive Works of Philadelphia in the early days of the War and were originally designed for 3-ft. 6-in. gauge. Before delivery was effected, Russia collapsed and the engines were left on the Makers' hands. Attempts were made to effect a sale by altering them to suit the meter gauge, the F.M.S.R. taking two and a number went to the then Mesopotamian Railways. These engines had a 0-6-0—0-6-0 wheel arrangement with an axle load of eight tons. The principal dimensions were :—

Cyls : H.P. 13-in. dia. 22-in. stroke.
Cyls : L.P. 19-in. dia. 22-in. stroke.
Cpld : wheels 3-ft. 8-in. diameter
Boiler H.S. 1,308 sq. ft.
Grate area 19.3 sq. ft.
Total weight 71 tons 17 cwt.
Tractive effort 18,250 lb.

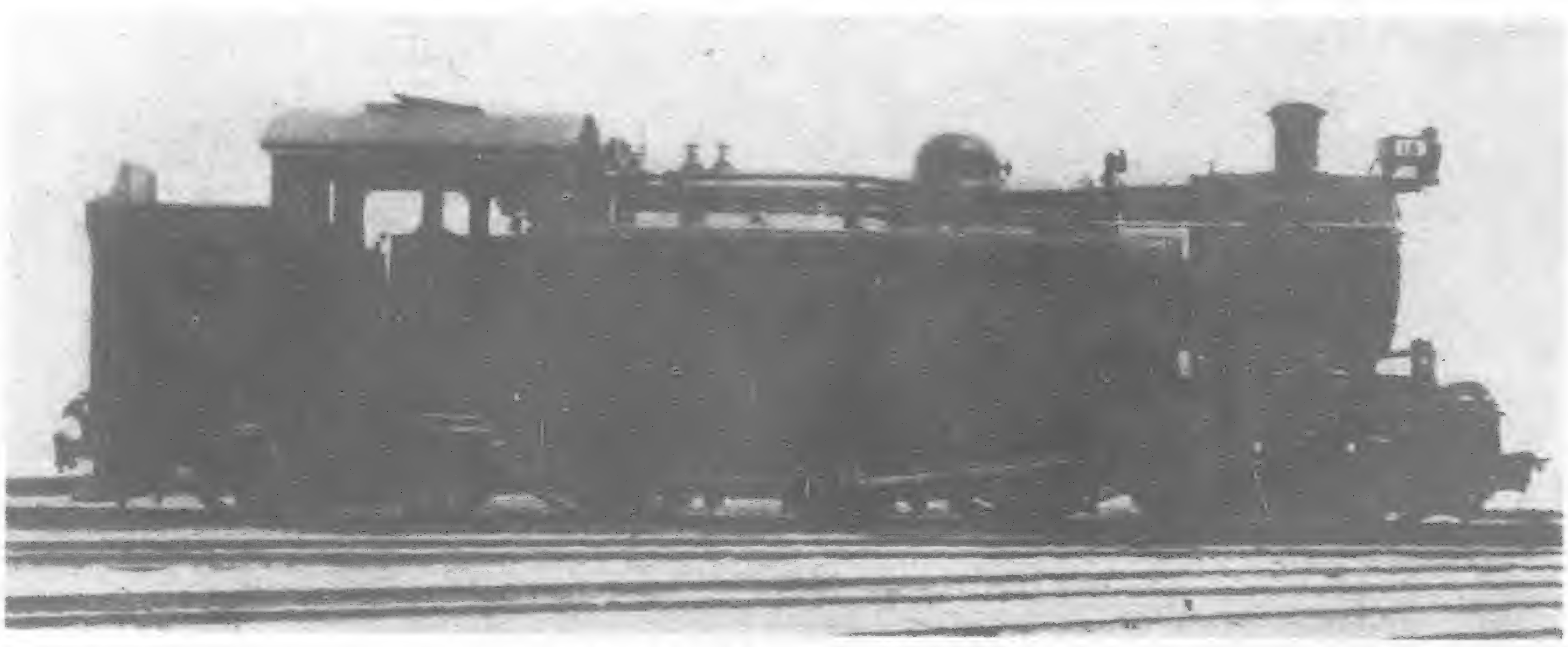
The tender mounted on a bogie and a single fixed axle, had water capacity of 2,122 gallons and fuel space of 256 cub ft.

Although relieving the situation at the time, the engines were not suitable for service on a railway the timetables of which were founded on the general utility principle, and their use was largely confined to the Port Swettenham branch.

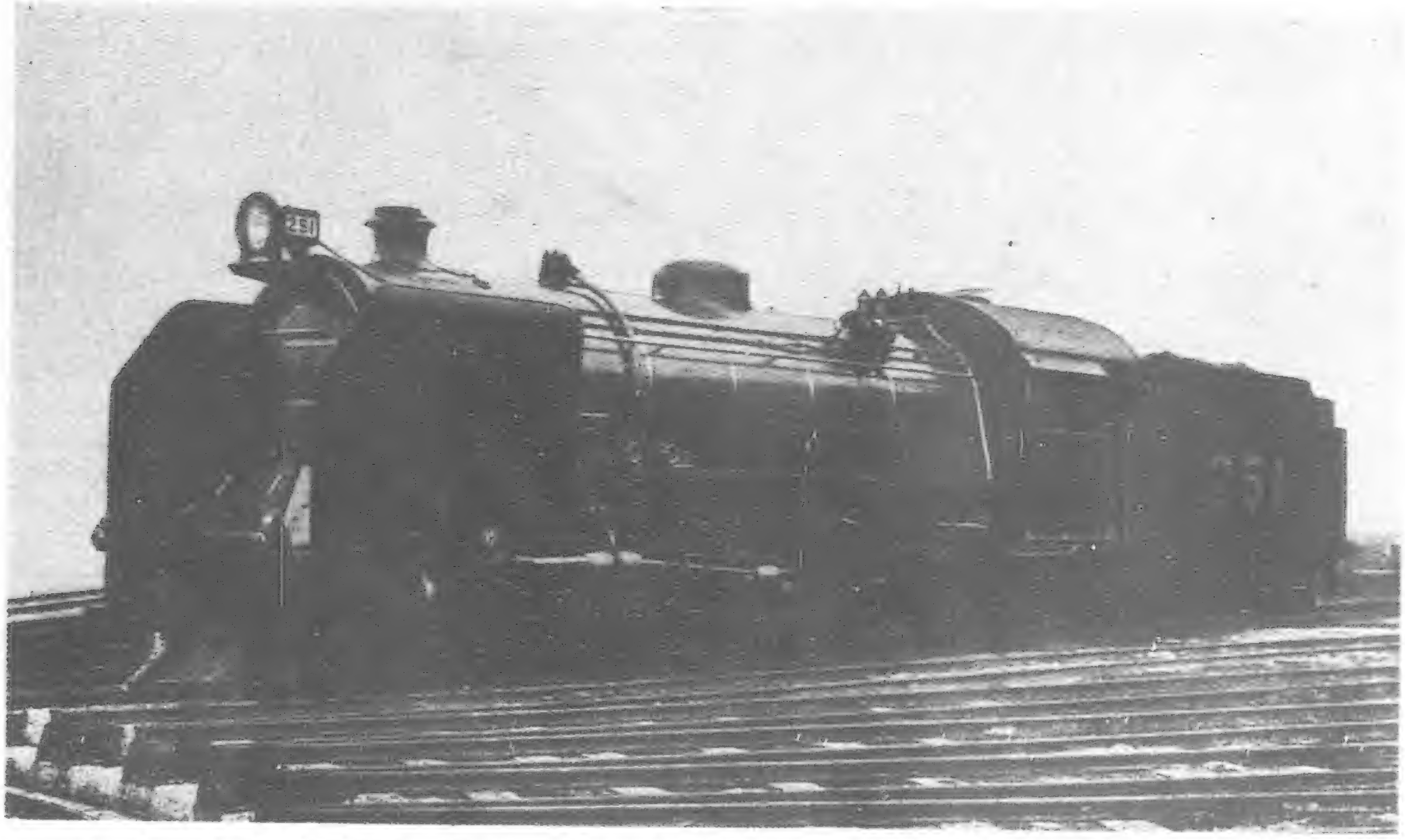
In 1919 an order was placed with Messrs. Baldwin & Co., for twelve 4-6-2 engines. These were of American design and the following principal dimensions :—

Cyls : 17-in. dia. 24-in. stroke.
Cpld : wheels 4-ft. 6-in. dia.
Axle load 10 tons 10 cwt.
Weight 79 tons.
Boiler grate area 24.9 sq. ft.
Total heating surface 1,403 sq. ft.
Boiler pressure 170 lb.

The steam was superheated and the total tractive effort was 18,553 lb. The eight wheeled tender carried 2,056 gallons of



" C " Class Locomotive (1930)



"S" Class Locomotive with Rotary Cam Valve Gear (1932)

water and five tons of coal. These engines known as the "Q" class were the first in Malaya to be fitted with bar frames and steel fireboxes, a practice which has been found suitable for Malaya and developed in more recent British-built engines.

In 1920 further orders were placed with Messrs. Baldwin & Co. For open lines there were purchased ten 0-6-0 shunting tanks to replace the old "A," "B" and "C" classes which had either been condemned or turned over to Construction which was then being pushed forward in Pahang and Kelantan. They were classified as the "R" class and had the usual American characteristics, with bar frames and steel fireboxes. The cylinders were 16-in. dia. by 20-in. stroke and the coupled wheels 3-ft. 6-in. in diameter. They were somewhat heavy and very powerful engines for their size, the driving axle load being 12 tons and the tractive effort 17,554 lb. For construction lines there were purchased ten 2-6-0 tender engines having cylinders 14-in. dia. by 18-in. stroke, and the coupled wheels 3-ft. 1-in. in diameter. The driving axle load was 9 tons 9 cwt. The total weight, including the eight wheeled tender, was 53 tons 8 cwt., the tractive effort being 12,257 lb. These engines, known as the "M" class, did good work on the construction lines, but were of little value for open line work on account of the small size of driving wheel. The "R" and "M" class engines were delivered in 1921.

In the meantime, a want of a more powerful engine was being felt. The Singapore night mail trains were loading beyond the capacity of a single engine and "double-heading" was the order of the day. The designs for an engine of greater axle load had been under discussion prior to the outbreak of the War, but it was not until 1920 that the matter was again taken up and in that year an order for twenty 4-6-2 engines having a 12 ton axle load was placed in England. This class, known as the "L" class, had the following principal dimensions :—

Cyls : 17-in. dia by 24-in. stroke.
Cpld : wheels 4-ft. 6-in.
Bogie wheels 2-ft. 6-in.
Boiler H.S. 1,485 sq. ft.
Grate area 24.3 sq. ft.
Pressure 180 lb.
Tender water capacity 2,500 gals.
Fuel $6\frac{1}{2}$ tons.
Total weight 86 tons 10 cwt.
Tractive effort 19,645 lb.

A Belpaire firebox was incorporated in the boiler design.

Owing to the somewhat conservative ratio of adhesion adopted, these engines gave but a small increment of power over the "P" class, the boiler pressure of which had been then advanced to 180 lb. They performed most useful work however, and for a time were usually able to handle the night mails unassisted. They were fitted with the "Weir" system of feed water heating.

As a result of the financial depression of 1922, the locomotive stock of the Railway was more than adequate and it was not until 1926 that further locomotives were purchased. The need for a light shunting engine was then felt, suitable for wharf work at Port Swettenham and other places where the track required a limitation of axle load to eight tons. In that year, five 0-6-2 tank engines were bought. These locomotives have the following principal dimensions :—

Cyls : 13-in. dia. by 20-in. stroke.
Cpld : wheels 3-ft. 3-in. dia.
Boiler H.S. 422 sq. ft.
Grate area 9.6 sq. ft.
Pressure 170 lbs.
Water 750 gals.
Fuel $1\frac{1}{2}$ tons.

They were the first British built engines to have a steel firebox and were delivered in Malaya fully erected, being landed at Singapore by the Tanjong Pagar sheerlegs.

In 1926 an order was placed for seven Pacific type locomotives having an axle load of 12 tons. The five years which had elapsed since the "L" class had been put into service had shown the possibility of improvement in design, and the new "K" class, delivered in 1927, was a thoroughly modern engine in every respect. Standardization, however, had not been lost sight of, as the principal dimensions will show :—

Cyls : 17-in. dia. by 24-in. stroke.
Cpld : wheels 4-ft. 6-in. dia.
Pony and tender 3-ft. 0-in. dia.
Bogie 2-ft. 6-in.
Boiler H.S. 1,445 sq. ft.
Grate area 24.6 sq. ft.
Pressure 180 lb.
Tender water 2,500 gals.
Fuel 7 tons.
Total weight 91 tons 5 cwt.
Tractive effort 19,645 lb.

In addition to numerous small details which were common to the "L" and "P" class engines, the boiler itself was interchangeable with those of the "L" class. Plate frames were adhered to, but the steel firebox was adopted. Four more of these engines were bought in 1931. While adhering to the principle of interchangeability, the boiler design was altered to include additional combustion space in the firebox, a provision which has been found economical in the consumption of Malayan coal. The heating surface was in consequence reduced to 1,316 sq. ft. without impairing the efficiency of the boiler.

"Double-heading" was again the rule for the Singapore night mail trains, and it was felt that a still more powerful engine would cure this source of expense, and also effect more economical operation of freight traffic. There were, therefore, put into service in 1928 a three-cylinder 4-6-2 engine having an axle load of 16 tons. These locomotives, of which three were at first bought, had the following main dimensions :—

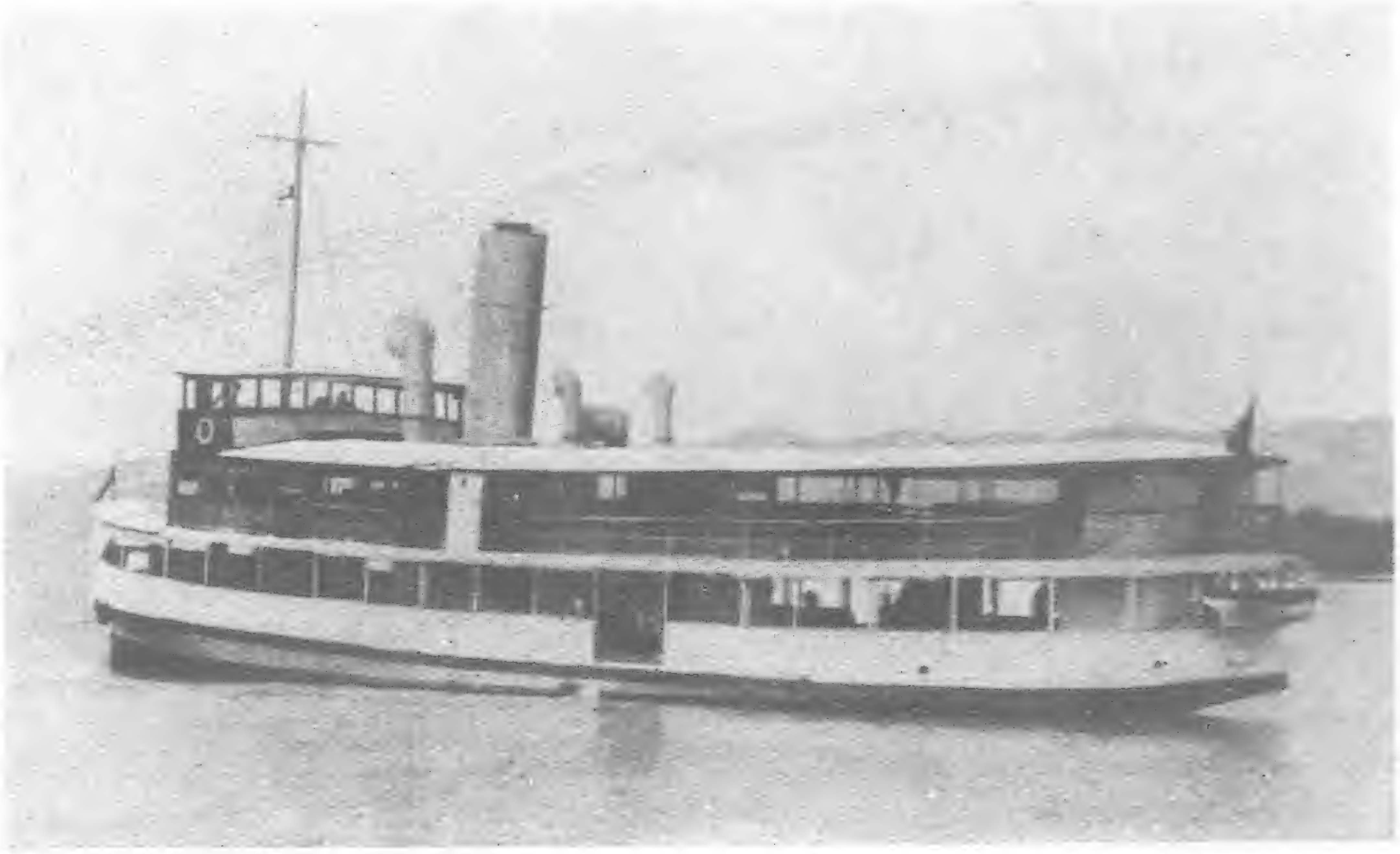
Cyls : 17-in. dia. by 24-in. stroke.
Cpld : wheels 4-ft. 6-in. dia.
Bogie wheels 2-ft. 6-in. dia.
Pony wheels 3-ft. 0-in. dia.
Boiler H.S. total 2,335 sq. ft.
Grate area 35 sq. ft.
Pressure 180 lb.
Tender water 3,000 gals.
Fuel 7 tons
Total weight 108 tons 9 cwt.

They had bar frames, steel fireboxes, the "Gresley" system of valve operation, and developed a tractive effort of 29,000 lb. They are capable of handling 15 coaches on passenger service or 800 tons on freight trains. This represents an increment of power of practically 33 per cent.

Eight more were built in 1930 and five in 1932, the latter being fitted with the Rotary Cam Valve mechanism, roller bearing tender axle boxes and an increased water capacity of 4,000 gallons of water and 10 tons of coal.

In 1930 there was delivered a new type of tank engine known as the "C" class. They had the 4-6-4 wheel arrangement. The principal dimensions are :—

Cyls : 14½-in. dia. by 22-in. stroke.
Cpld : wheels 4-ft. 6-in.
Bogie 2-ft. 6-in.
Boiler H.S. 1,026 sq. ft.
Grate area 23.6 sq. ft.
Water capacity 2,000 gals.
Fuel 158 cu. ft.
Total weight 73 tons
Tractive effort 19,272 lb.



S.S. "Violet" in the ferry service between Penang and Prai

These locomotives followed advanced practice, the boiler pressure having increased to 250 lb. while steam was distributed through the medium of the Caprotti cam valve gear.

To meet the demands of short branch lines, and pick up services, the Railcar system was again introduced, and in 1930 a Sentinel-Cammell Articulated Railcar set was introduced. Five more were bought in 1931. These vehicles were to the well-known designs of the Sentinel-Cammell firm. The steam, generated in a vertical boiler, is delivered to the six-cylinder engine at 350 lb. per sq. in. The engine is single acting, the steam distribution being controlled by cam operated valve. The drive is by a 6-throw crank shaft coupled to a carden shaft driving the bogie axle by means of a reducing gear.

In reviewing the locomotive practice of the F.M.S.R., the reader will realize, that although through circumstances over which the management had but little control, there are numerous types of engines, the principle of standardization has never been lost sight of, as witnessed by the predominance of the Pacific type wheel arrangement and the now almost universal wheel diameters. To this might be added a host of smaller details common to all classes. At the same time, designs have advanced with the times and it may reasonably be claimed that the locomotives of the F.M.S.R., while conforming largely to economic standards of maintenance, are yet fully representative of modern locomotive engineering.

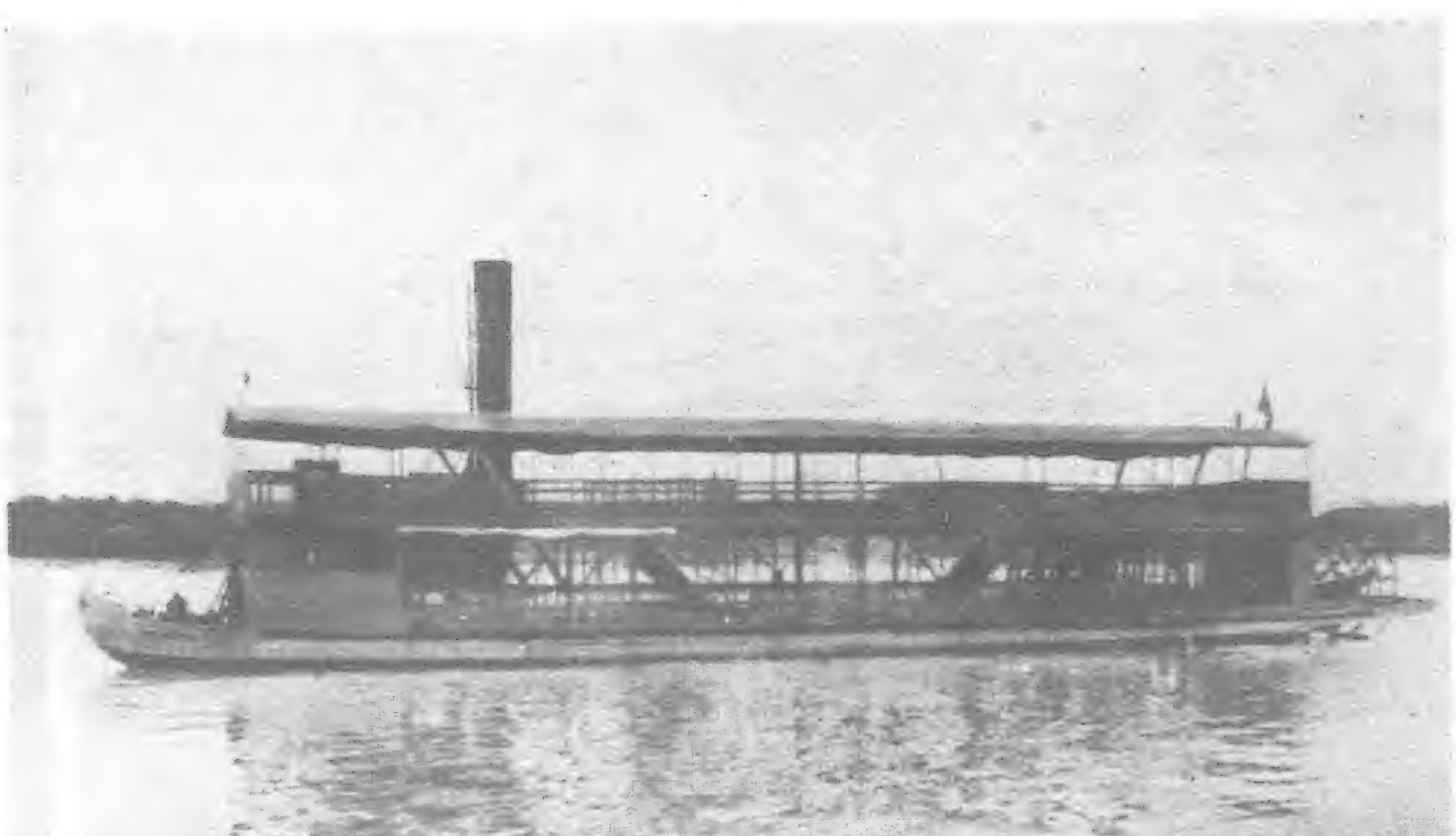
Locomotive Running Shed, Kuala Lumpur

At Kuala Lumpur are stationed the locomotives which work the mail trains and heavy through goods and mixed trains from Singapore in the south to Taiping in the north, besides numerous other main line and branch trains and in 1932 a new locomotive running shed, which in view of its modern equipment is worthy of a detailed description, was completed for their accommodation.

It will be seen from Fig. 1 that the shed is of the roundhouse type, having 26 stalls radiating from the central turntable. The building throughout is of reinforced concrete, and is designed to give a maximum amount of light and air together with adequate protection against the direct rays of the sun and also from heavy rainstorms.

The locomotive arrival line leads to two ashpits, which are provided with sumps and electrically-operated hoists, the skips of which discharge into ash wagons placed midway between the two pits. Water columns are suitably located for filling tenders while fires are being dropped.

From one of the ashpits direct access to the shed is obtained, but from the other the locomotive goes to the coaling plant. This plant is of the skip type, electrically driven. The coal is delivered in 40 ton hopper wagons and dropped into an underground hopper having at the bottom a revolving table by which the skip is fed. The table is controlled automatically and the delivery of the coal ceases when the skip is full. The skip, the capacity of which is 20 cwt., is then hoisted and discharges into an overhead hopper of five tons capacity. Coal is delivered to locomotive tenders through lever-controlled doors so arranged that approximately 10 cwt. are delivered at a time. A view of the plant is given in Fig. 2. On leaving the coaling plant the engine passes the sand drying furnaces where sand boxes are filled. Thus on entering the shed the locomotive is fully equipped for its next turn of duty.



S.W. "Shamrock," shallow draught steamer in ferry service between Palekbang and Kota Bharu (Kelantan)

The turntable, Fig. 3, is 60-ft. in diameter and of the overgirder type. The propelling unit consists of a special frame and housing attached to one end of the table and supported on a wheel running on the race rails. This wheel is 2-ft. in diameter and is driven by a 5-h.p. motor through the medium of suitable gearing.

Ten of the 26 stalls are provided with short smoke troughs, and it is on the pits so fitted only, that engines which have fire on their grates or are to be lit up are stabled. The remaining berths are supplied with direct steaming connections whereby engines are held in steam during the time spent in the shed. When required for service they are taken under their own steam to the out-going road, where fires are lit. They are thus ready for duty in a very much shorter period than by the usual method, while the shed is kept clean and clear of all smoke.

The direct steaming equipment has been evolved by a well-known firm in conjunction with their hot washing-out system and in accordance with information supplied by the railway administration. This system is well known and

Fig. 3—60-ft. Electrically operated turntable

it need only be said that the contents of the boiler are blown down through a special pipe range. The escaping steam is used to heat fresh filling water and the hot water discharged, after being freed of impurities, is used for washing out. To this system, which is entirely automatic and under the control of the washing out gang, has been added a steam pipe range with valve connections to the flexible blow down pipes.

On completion of the work of washing out and filling, the steaming valve is opened by means of which the engine is coupled direct to the steam range. On the pressure of the boiler reaching that of the range the main steam valve is closed


Fig. 2—Electrically worked coaling plant (right) and ash-handling plant

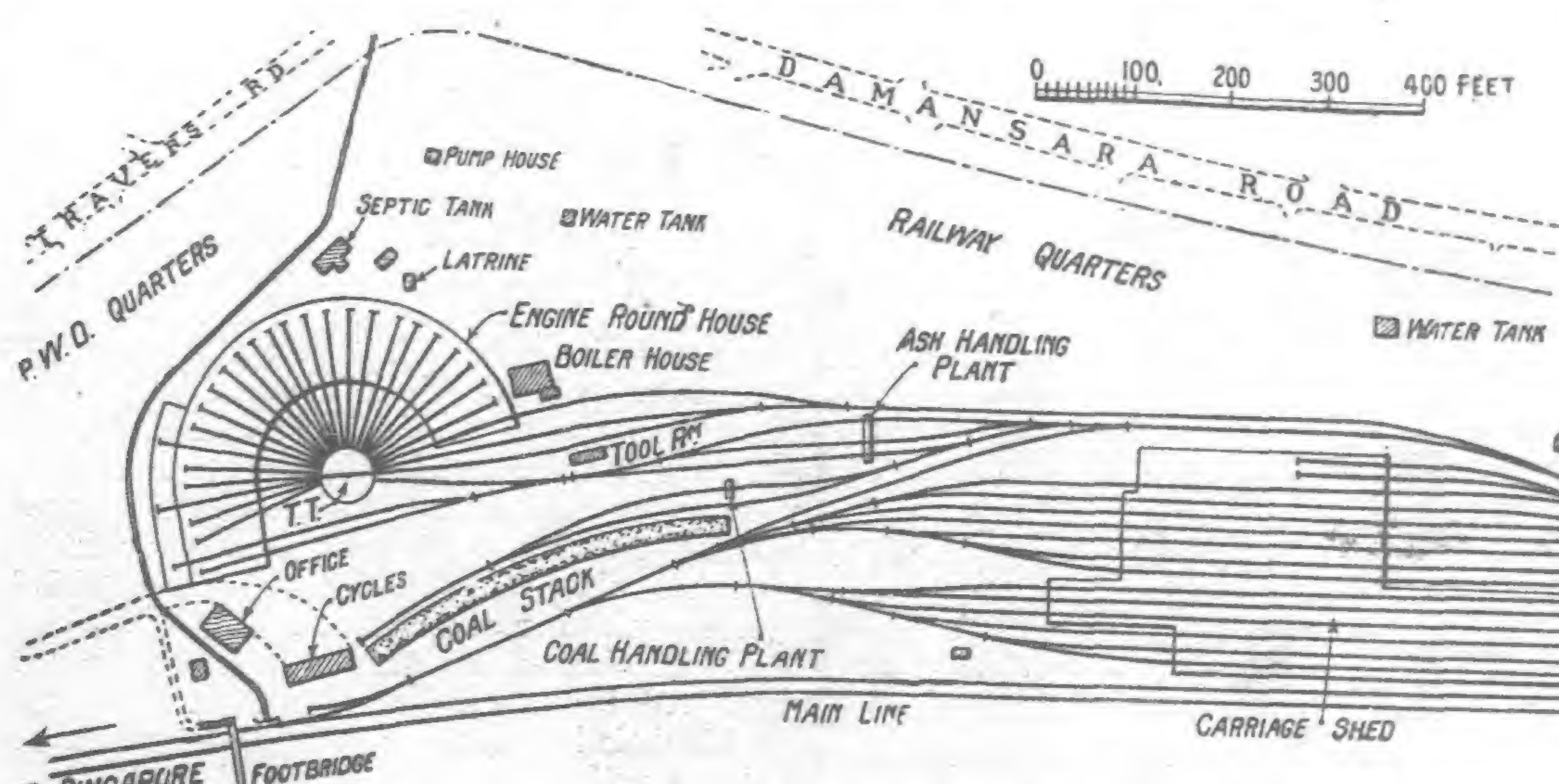
and the floating valve is opened whereby the boiler is kept under pressure by means of steam passing through a bye-pass in the main range. Fig. 4 is an interior view showing the pipe ranges and connection to the blow-off cock of the locomotive, and Fig. 5 is a view of the plant. Steam is provided by a Babcock and Wilcox boiler having 2,197 sq. ft. of heating surface. It has been found that it takes 20 to 30 minutes to blow down a boiler according to the steam pressure and quantity of water in the boiler, 10 minutes to fill, and about 20 to 30 minutes to steam it to 120 lb. per sq. in. Thus the time saved as compared with the old system is considerable, while cooling and expansion stresses are largely eliminated.

It will be seen from Fig. 1 that there are five direct roads into the shed, three of which avoid the turntable. Two of these roads lead direct to a small workshop and here is located one hand-operated and also one electrically driven drop pit. This pit is of sufficient capacity to handle all sizes of wheels as well as engine and tender bogies complete. After the wheels are lowered they are traversed and again raised to rail level where the necessary repairs are then effected. An overhead jib crane is provided to enable the wheels to be loaded into wagons if it is necessary to dispatch them to the railway workshops. Adjacent is a small workshop containing the few machine tools necessary to execute immediate running repairs. A storeroom is provided and is served by one of the direct roads leading over the turntable. The water supply is pumped from the canalized overflow of an adjoining lake. The electrically-driven plunger pumps are in duplicate and capable of delivering 200 gallons a minute against a total static and frictional head of 134-ft.

The old locomotive shed which was vacated when the new premises were occupied has been converted for use as a carriage shed and its equipment includes inspection pits, carriage lifting hoists and a water supply. It is here that carriages are cleaned and given periodical examinations to ensure that they are in proper running order. Attached to this building is the specially equipped bedding store from which the beds and linen for the night mail trains are supplied direct to the carriages.

Locomotive Mileage

For some considerable time, railway locomotive engineers and



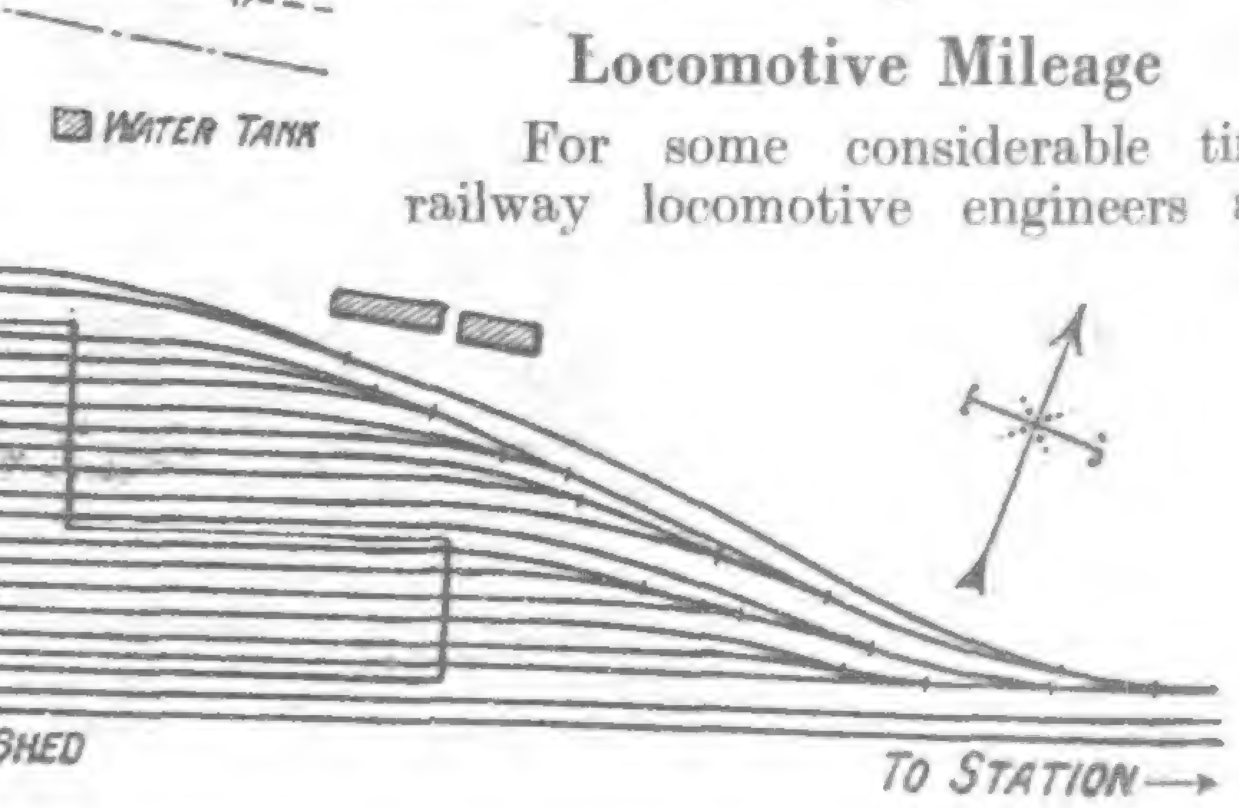
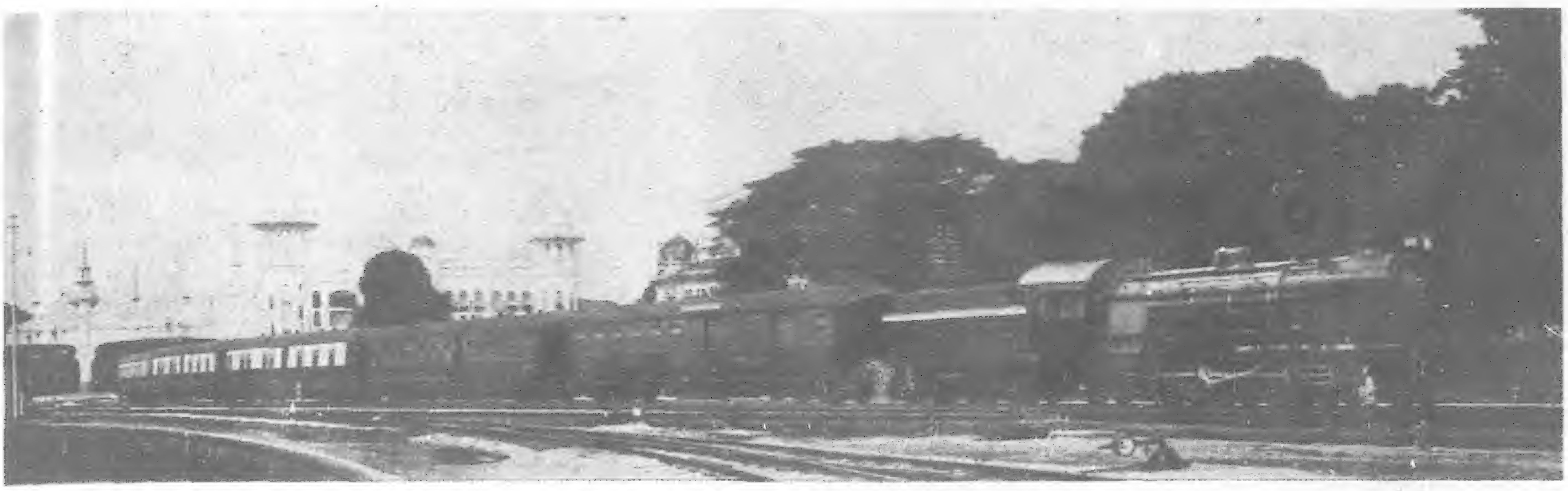


Fig. 1—Layout of the locomotive depot at Kuala Lumpur



Singapore-Penang express train leaving Kuala Lumpur

operating officers all over the world have been endeavoring to increase the daily mileages of locomotives with the object of speeding up trains and reducing the number of locomotives required, and consequently capital costs.

No effort has been spared by the Federated Malay States Railways to effect improvements in this direction, and although handicapped by comparatively low speeds, limited distances and many other factors, the results have proved most satisfactory.

It is only on the mail trains, night mixed and goods trains running between Prai (for Penang) and Singapore, a distance of 488 miles, that long runs can be obtained in this country. Prior to 1934, the mail train engines were booked to work between Taiping and Kuala Lumpur, a distance of 184 miles, and between Seremban and Singapore, a distance of 199 miles, without a change, but in August that year, after effecting improvements to the locomotives, the mail train engine runs were extended between Kuala Lumpur and Singapore, a distance of 245 miles.

The extension of these runs and a similar extension of the locomotive runs of the night mixed and goods trains allowed the concentration of locomotives at Kuala Lumpur where the up-to-date running shed and equipment facilitate the quick "turn-round" of engines, thus enabling them to be kept in a high state of efficiency.

In December, 1934, after experience of this working had been obtained, five 3-cylinder express locomotives were selected to take up all the mail train workings between Taiping and Singapore. Four locomotives were employed daily on these runs and one reserved for relief purposes. Commencing from Kuala Lumpur with the day mail trains, the locomotives ran to Taiping and to Singapore, arriving there the same afternoon in sufficient time to leave on the night mail trains. They were thus back again in Kuala Lumpur the following morning in time to work the day mail trains. This program continued day in and day out throughout the month, each locomotive being released for a day in turn by substitution of the spare to enable running repairs to be carried out.

During the month referred to above, the following mileages were run :—

Engine No.	238	S1 Class	..	10,354 miles.
,,	246	S2 ,,	..	10,233 ,,
,,	247	S2 ,,	..	11,141 ,,
,,	250	S3 ,,	..	10,057 ,,
,,	252	S3 ,,	..	10,465 ,,
				52,250

Average per engine 10,450 miles.

Although running over 1,600 miles daily during this period, none of the trains, which frequently consisted of 16 heavy coaches, were delayed by any engine defects.

(*Continued on page 372*)

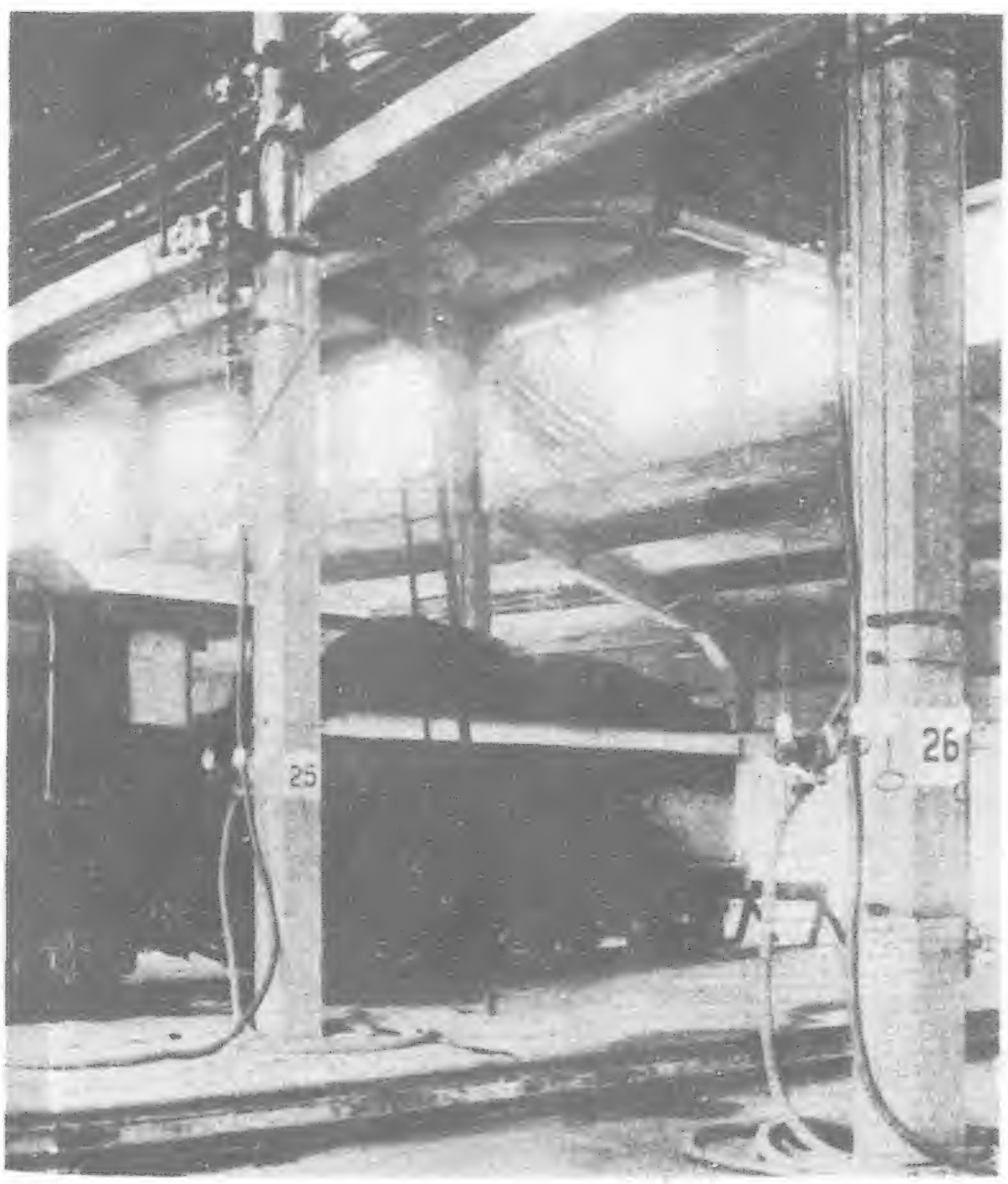


Fig. 4—Pipe ranges and connection to blow-off cock of locomotives

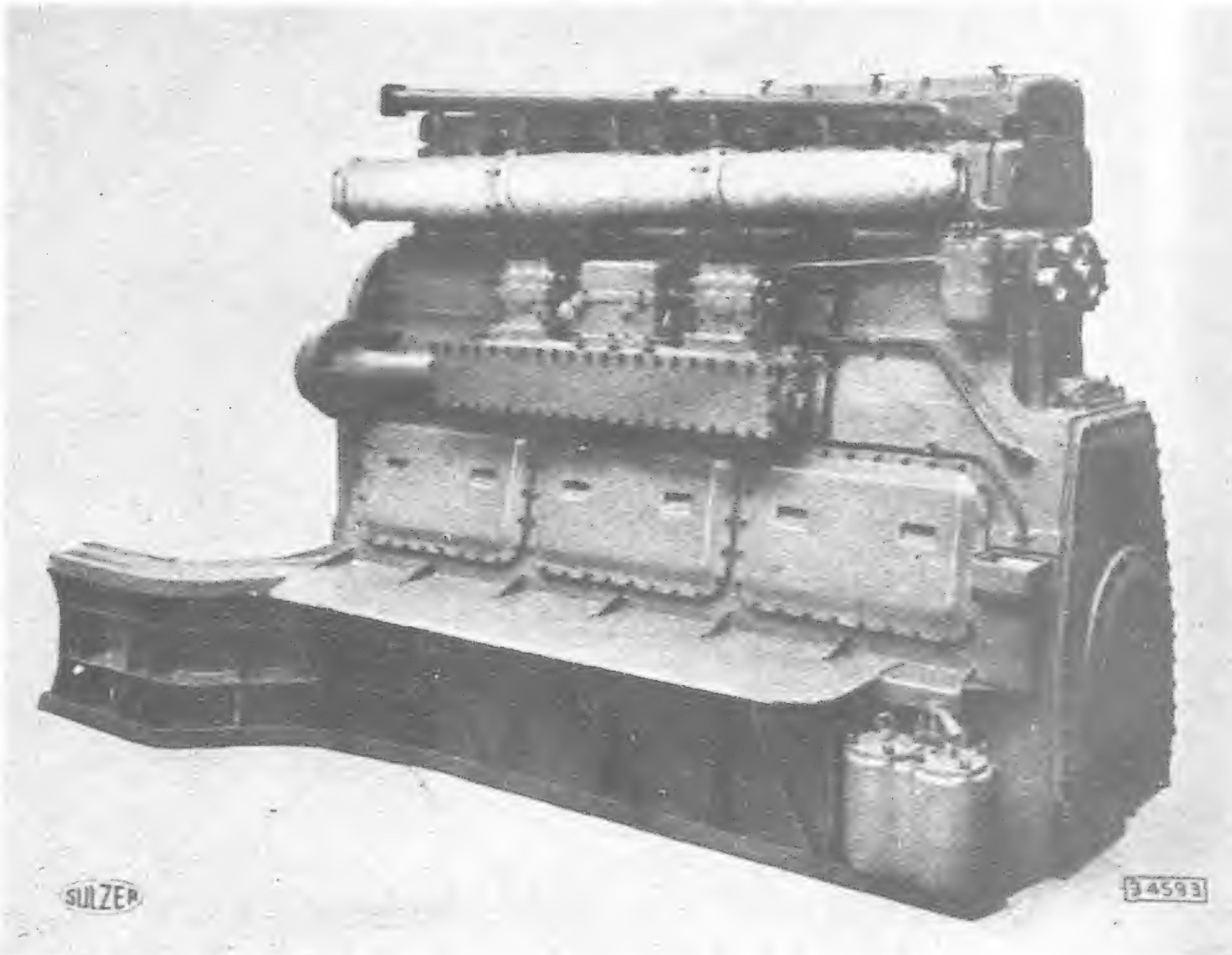
Fig. 5—The direct steaming plant

Sulzer Engines Used for Diesel Electric Cars in Manchoukuo

SULZER BROTHERS have recently supplied to the South Manchuria Railway Co. four Diesel engines which are coupled to D.C. dynamos and fitted into rail cars. The engines, one of which is shown were built in the Sulzer works at Winterthur, whilst the dynamos and the cars are being built in Japan. Each of these 6-cylinder engines develops at one-hour rating 500 b.h.p. at 900 r.p.m., and continuously 460 b.h.p. at 830 r.p.m. The fuel consumption determined on the test bed was

	900 r.p.m.	*830 r.p.m.*
at 4/4 load	175	171 gr/b.h.p.-hour
at $\frac{3}{4}$ load	180	178 ,,

The output was measured partly with an hydraulic brake and partly with an electric generator.



Six-cylinder four-cycle Sulzer Diesel engine developing 500 b.h.p. at 900 r.p.m. With welded bedplate and cylinder block, built for a rail car of the South Manchuria Railway

As can be seen from the illustration, this new type of engine is of very compact design. To reduce the weight, cylinder block and bedplate consist of a combination of cast steel members and steel plate, the former being welded to the latter as in previous Sulzer designs. The bedplate is designed as a rigid girder and is extended and widened at one end to carry the dynamo. Great resistance to deformation through the external forces and moments to which it is subjected is obtained by making this frame in one piece and of a good depth. Particular attention was paid to the design to ensure good distribution of the forces caused by combustion and acceleration. For this purpose each crankshaft bearing support is designed as a U-shaped strap, which has its upper ends firmly secured to the cylinder block. The cylinder block itself consists in its upper part of a cast steel transverse frame ; the side walls are welded on this frame and the cylinder liners are inserted into it from above.

To facilitate inspection, each cylinder has a separate cover in which the suction and exhaust valves and also a centrally located fuel valve are fitted. These covers are light and can easily be removed without dismantling the valve gear. The fuel valve, arranged in the center of the cylinder cover, allows fuel injection with symmetrical distribution and so gives even heat stressing of the aluminium piston, which is pressed from one piece of metal.

The cam shaft is supported in bearings at the side of the cylinder block and is direct driven from the rear end of the crankshaft by means of toothed gearing. A separate horizontal shaft is arranged on the side of the cylinder block to drive the fuel pumps and the governor. The fuel pumps can be seen in the illustration ; they are arranged in two blocks, one on either side of the governor. The latter can be controlled from the driver's cab to adjust the engine to any one of three different service speeds.

The design described above allows top overhauls to be made without having to remove the engine from the car. Even at the general overhauls it is not absolutely necessary to remove the engine, since all parts are easily accessible and detachable. The whole engine is automatically lubricated and requires no supervision while running. The moving parts are protected from dust, and the combustion air is drawn in through a filter fitted in front of the suction branches, so that no dust can enter the lubricating system in this way. Twin lubricating oil filters are provided; they can be replaced or used alternately while the engine is running. Particularly low lubricating oil consumption is ensured by careful design of the piston.

Other engines of similar type, but of smaller output have recently been supplied by Sulzer Brothers for four rail cars for the Ferrocarril Provincial, Buenos Aires ; they are also building the engines for two high-speed rail cars for the Swiss Federal Railways. A series of ten engines of the type described above, with an output of 400 b.h.p. at 1,000 r.p.m. is being built by Messrs. Sir W. G. Armstrong, Whitworth & Co. (Engineers) Ltd. for the London, Midland and Scottish Railway. This firm is also at present building nine engines, each developing 290 b.h.p. at 1,200 r.p.m., for the Central Argentine Railway.

History of General Motors, Japan, Ltd.

(*Continued from page 350*)

In a recent statement made by Mr. Alfred P. Sloan, Jr., President of General Motors Corporation, he estimated the sales of 2,000,000 General Motors cars and trucks for the year 1936.

Each year, as new models are introduced General Motors strives to pioneer and give the purchasers of its cars and trucks the finest automotive units that science and engineering can produce at the lowest possible cost. An average of $20,000,000 yearly is spent in doing this for special tooling. It believes that progress is accelerated by the interpretation of new and advanced designs in as many different forms as are sound and commercially desirable. Its policy is to give the broadest possible scope for opportunity and development to its various engineering departments. By so doing progress is stimulated.

The following features and contributions to safer driving pioneered by General Motors are important characteristics of its 1936 motor-car products :—

The solid steel "Turret Top" Body by Fisher, a construction which not only eliminates the soft spot of fabric overhead, but also buttresses and reinforces the whole car structure.

Knee-Action which contributes not only to a vastly better ride, but to safety and surety of control as well.

Fisher-no-draft ventilation, which provides clearer, safer vision, by keeping the inside of the windshield and windows from fogging in cold weather or rain, and also protects health by eliminating chilling drafts.

Improved hydraulic brakes, engineered to a new standard by General Motors, for safer, smoother, straight line stops to offset the powerful engines which the public demands to-day.

It is an honor to be the largest builder of automobiles and trucks in the entire world, but it carries with it the responsibility of being pre-eminent in research, engineering and manufacturing.

General Motors will continue to accept that responsibility and the challenge to its leadership year after year by manufacturing the best automobiles and trucks the market offers.

Ayer Hitam Filtration Plant at Penang

By J. W. PERKINS, B.A. (Cantab.)

(Following is a paper read at the 1935 annual general meeting of the Engineering Association of Malaya at Penang.)

AYER Hitam Settling Chambers and Storage Reservoir were constructed during 1911-1915, the water being brought through an 18-in. main from the intake higher up the main Ayer Hitam Stream. Prior to the installation of the filter plant it was necessary to shut down the supply at the intake whenever it became discolored after rain, as the period of settlement, eight hours, was insufficient to clear the water. This method, although somewhat inconvenient during continuous rainy weather owing to the small capacity of the reservoir (4,000,000 gallons), proved adequate until an exceptionally severe storm on November 24, 1932, damaged the catchment area so badly that the water was thereafter always discolored. Many landslides took place blocking streams, which were forced to cut new channels, and removing the natural filtering media from large areas of catchment. Cleaning and reveting of banks, and replanting of denuded areas were put in hand, but the improvement in the water obtained was not sufficient to justify continuance of this work and it was decided that filtration was essential.

Typical reports on the water were as follows :

(*a*) "Chemically, there is no evidence of pollution from either animal or vegetable sources and in my opinion all four samples are quite safe for drinking purposes. The discoloration and the turbidity are solely due in my opinion to the presence of fine clay in suspension. Total solids 84 parts per million."

(*b*) "The sample was highly colored—a reddish brown—and was very turbid........the total solids were estimated at 1,950 parts per million."

The bacteriological analyses showed generally that B. Coli were absent in 10 CC and frequently absent in 100 CC.

Laboratory tests on samples of this water with varying doses of sulphate of aluminium and lime seemed to indicate that rather unusually high doses might be required and it was decided before calling for tenders to construct a battery of small filters complete with sedimentation tanks, and to carry out experiments on a small scale with various coagulants. The whole of this experimental plant, except for the settling tanks which were of brick, cement rendered, was constructed from materials taken on loan from our Stores and which have now been returned to stock undamaged. The cost of this work was thus only for labor and chemicals, very little material being wasted. I have here detailed sketches of the type of filter we used which may be of interest to anyone contemplating similar experimental work.

The filters, of which there were four, two of 15-inch and two of 12-inch diameter, were constructed from C.I. pipes and specials as shown in the drawing. The steel plates were specially cut and drilled, but all other materials have been returned in good condition and are fit for use.

General view of experiment plant with settling tanks and chemical apparatus in background

The unfiltered water entered upwards through three small galvanized pipes led through bolt holes in the flanges of the two flange and spigot tail pieces into the annular space surrounding the top of the filter bed. Wash water was carried off through the same pipes.

It would no doubt be possible to construct similarly a pressure filter cleaned by rakes, which might be useful if neither compressor, pumps or tanks are available. The filtered water tank would in this case of course be at least 20 feet above the filter.

A constant head of six feet was maintained over the filter beds, the attendant regulating the 2-in. filtered water outlet valve as required. The rate of flow throughout all the tests was 100 gallons per square foot of bed per hour.

The system of upwashing, although somewhat reminiscent of Mr. Health Robinson's remarkable contrivances, proved quite satisfactory in actual use. Air scour was first provided by a small Holman compressor, and then the steel truck acting as a filtered water reservoir was hauled to the top of the slope some 25 feet above the filters by a winch, thus obtaining the necessary head to upwash the filter bed. The need for a pump or pumps, of which we have none suitable, was thus avoided by making use of trucks, rails, and a winch, of which we have plenty. The interior of the trucks was coated with a white enamel before use.

Four different chemicals were used in these experiments, sulphate of aluminium or alumina; sodium carbonate or soda ash: lime; and sodium aluminate.

Five combinations of coagulants were used :—

(*a*) Alumina alone
(*b*) Alumina and lime
(*c*) Alumina and soda ash
(*d*) Alumina and sodium aluminate
(*e*) Sodium aluminate alone.

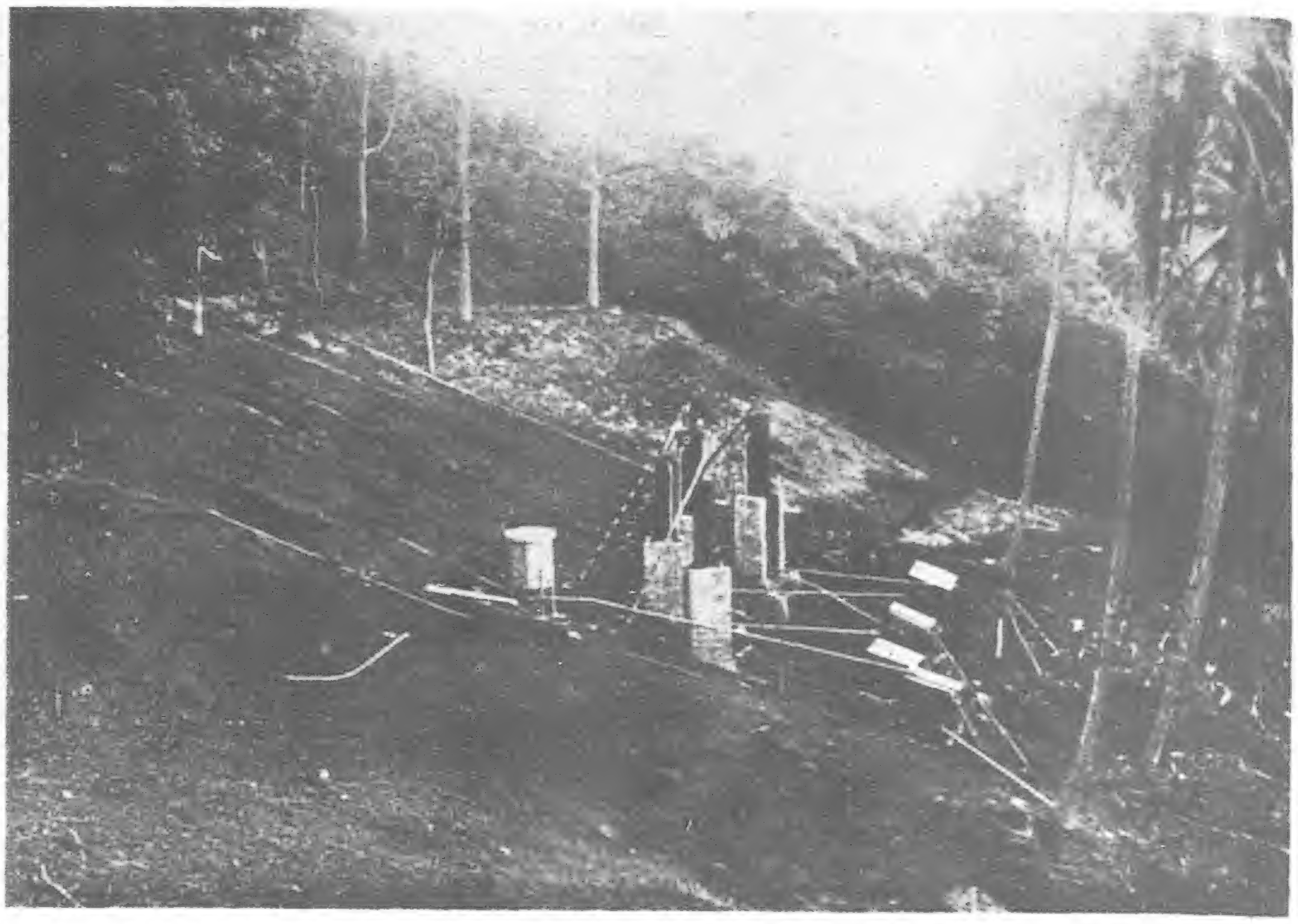
Alumina having a corrosive action on galvanized iron, Shanghai jars were used as dissolving and feed tanks for this chemical and for sodium aluminate, while two old galvanized tanks were used for soda ash and lime.

From the dissolving tanks and jars the solutions were led by rubber piping to small ball valve tanks which maintained a constant head on adjustable orifices at the end of rubber pipes leading to the inlets to the settling tanks. The ball valve tank for alumina was constructed of concrete. Considerable trouble was experienced in maintaining a constant dosage, particularly with small flows, owing to partial choking of these small cocks, and it seems probable that a better arrangement would be to use fixed orifices and to regulate their depth below the constant level of liquid in the ball valve tank. These orifices should be large enough to pass

any small undissolved particles unless strainers can be fitted. Ball valves having a fairly large waterway should be used so that a very small movement of the float will give a considerable increase in flow, otherwise it will be found that, with the larger flows, the level in the ball tank falls after the rate has been adjusted and constant regulation is required. The solution tanks were provided with calibrated gauges as a check on the doses which were set by means of a graduated beaker and stop watch. Solutions of constant strength were used, the flow being varied as required, but for more accurate work it might be easier to arrange for a constant flow and vary the solution strength, particularly if the experimenter can only visit at intervals to take results and not give continuous supervision.

The inflow of raw water to each tank was measured by $\frac{3}{8}$-in. Frost's meters, with a 45° V-notch in a small tank as a quick check. The chemicals were added in these weir tanks and immediately below the weir to ensure good mixing.

The sedimentation tanks were designed to allow six hours settlement. Under and over wooden baffles were provided, the treated water finally spilling over brick baffles into small chambers whence it was led to the filters through 2-in. pipes.



General view of experimental filters ; Penell-Wylie upward flow filter on left

Experiments were started at the end of August, 1933, and carried on until the end of November. At the end of October the period of settlement was reduced to four hours only, this being the period of settlement provided by one of the old settling chambers with a flow of 3,000,000 gallons per day. In November a 3-ft. 6-in. diameter Penell-Wylie upward-flow filter was kindly lent by Messrs. Guthrie & Co., for comparison with the more usual type of filter. I shall deal with this filter in more detail later.

The pH values and turbidities of raw, treated, and filtered water were taken. A capillary tube set was first used for pH, but a larger buffer tube set used later proved more convenient for use on site in view of the difficulty in cleaning the capillary tubes. For turbidities, the Paterson turbidity meter was used and proved very handy indeed. This instrument is in use at the filter plant, but for the benefit of those who have not seen it, it consists of two parallel mirrors in a dark box fitted with a small electric lamp which shines through a hole in the end of one mirror. The water to be tested is poured into the box and through a peep hole on the other side of the box a varying number of reflected spots of light are visible according to the turbidity of the water. A slide is moved to touch the last spot visible when a pointer attached to it indicates the turbidity in parts per million. For turbidities above 15 it is necessary to dilute the water under test with distilled or filtered water of a known turbidity.

The main objects of the experiments were as follows :—

(*a*) To determine whether lime, or soda ash, if either, should be used with alumina.

(*b*) To determine if any advantage would be gained by the use of sodium aluminate.

(*c*) To determine the maximum doses of the various chemicals for which provision should be made in the full size plant.

The turbidity of the raw water varied from about 20 in very fine weather to 2,400 parts per million after a heavy storm. The normal turbidity in fair weather was between 25 and 30 p.p.m. and as mentioned abov^c the period of settlement was varied from six to four hours.

I give below various typical results that bring out quite clearly the effect of the various chemicals. The " comparative cost " is obtained by taking the price of alumina as unity, the comparative costs of the other chemicals at the time of these tests being

Sodium aluminate	4.1
Soda ash	1.35
Lime	0.49

DETAILS OF EXPERIMENTS

SIX HOURS SETTLEMENT. (All doses in gr/gall.)

Alumina	*Soda Ash*	*Sodium Aluminate*	*Lime*	*Turbidity*			*Cost (comparative)*
				Raw	*Settled*	*Filtered*	
0.82		0.12		27	not taken	0.8	1.32
		0.54		27	" "	15	2.21
0.76		Trace		21	21	2.3	0.77
0.7				21	30	2.3	0.7
0.76	0.46			21	44	9.5	1.38
0.55			0.15	22	17	3.3	0.62
0.87			0.39	22	14	2.3	1.06
0.5				22	15	2.8	0.5
0.72	0.23			22	17	2.8	1.03
0.56		0.07		50	36	4.3	0.85
0.56				50	36	2.7	0.56
0.75	0.19			50	36	3.8	1.01
1.25			0.44	50	30	3.2	1.47

FOUR HOUR SETTLEMENT

Alumina	*Soda Ash*	*Sodium Aluminate*	*Lime*	*Turbidity*			*Cost (comparative)*
				Raw	*Settled*	*Filtered*	
1.07		0.04		23	37	2.3	1.23
1.02			0.55	23	27	2.2	1.29
1.68				23	60	1.9	1.68
1.05	0.44			23	22	3.2	1.65
1.03		0.06		80	45	3.2	1.27
1.95			0.51	80	45	2.7	1.2
1.02				80	45	4.4	1.02
0.97	0.5			80	22	2.7	1.64

The above results are for what may be called the normal water. Below are some figures obtained with more turbid waters obtained after heavy rain.

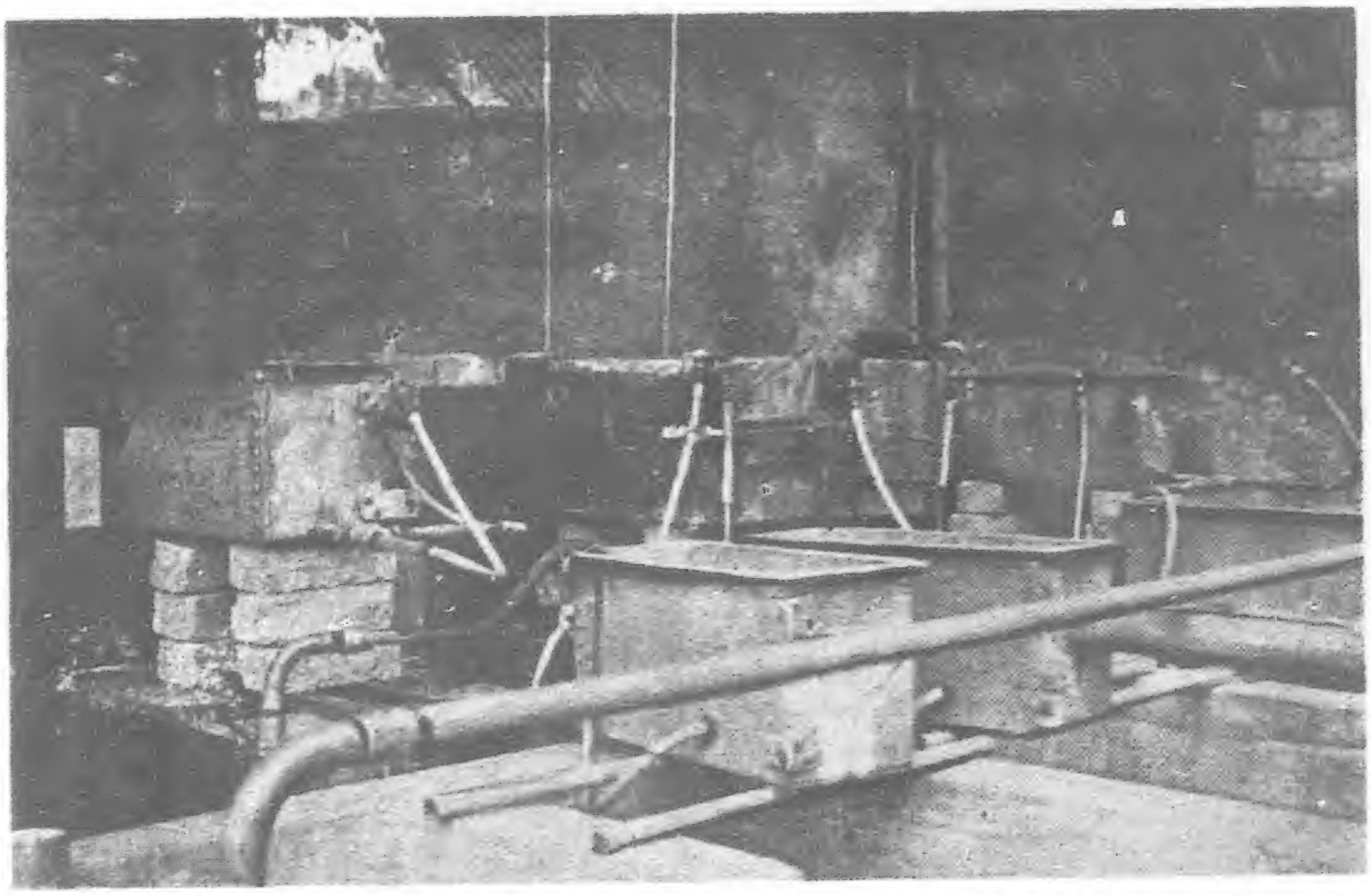
FOUR HOURS SETTLEMENT

2.48				240	65	4.4	2.48
2.46		0.06		240	65	2.7	2.7
2.6	1.37			240	37	5.2	4.45
2.52			1.27	240	76	2.7	3.14
2.37				2400	62	3.2	2.37
2.02		0.08		2400	62	3.2	2.35
1.98	1.07			2400	30	3.1	3.42
2.18			1.16	2400	62	2.7	2.75

The chemical doses here are those that happened to be in use when the turbid water suddenly came down, and are probably far higher than necessary.

The results obtained may be summed up as follows :—

(a) During fine weather the use of lime or soda ash in conjunction with alumina proved unsatisfactory as it was found that, no matter what combination of doses was used, better results were obtained with alumina by itself than with either alkali and in fact that more lime or soda ash added the worse the filtrate. After rain, however, with a more heavily charged water, the use of soda ash or lime was decidedly necessary to obtain a good filtrate. Soda ash generally caused a greater proportion of the suspended solids to be deposited in the sedimentation tanks than did lime, but it is more expensive to use. In addition to this it was considered that it would prove necessary to add a small dose of lime to the filtered water, so that it was finally decided to install a lime plant arranged to dose either the raw, treated or filtered water.



Constant head tanks with chemical feed pipes above ; weir tanks for measuring rate of flow of raw water below

(b) With raw water of comparatively low turbidity, i.e. not more than 30 p.p.m. it was found that by the addition of a very small dose of sodium aluminate (0.05 to 0.1 gr/gal.) to the raw water before dosing with alumina a far larger proportion of the solids was deposited in the settling tanks than when using alumina alone. The filtrate did not appear to be any better with alumina and sodium aluminate than with alumina alone, but the improvement in the treated water prior to filtration was so great that it was thought that the small extra cost of the sodium aluminate would be more than balanced by the saving obtained by increasing the length of runs between upwashings.

This effect was not so marked with four hour settlement as with six hour, but the raw water during the four hour tests was generally worse than during the six hour.

With a more turbid water the advantages of sodium aluminate disappeared and it was found that lime or soda ash gave better results.

The use of sodium aluminate alone proved unsatisfactory, as was expected, but apart from the results the high cost of this chemical prohibits its use in other than very small quantities.

General view of settling tanks, filters and filter house

Some tests carried out on a small scale with water of a turbidity of between 20 and 25 p.p.m. showed that while alumina with soda ash produced the best floc in a very short time, with alumina and lime a good second, alumina and sodium aluminate required about two hours to show a floc. Once formed the floc increased in size and settled rapidly, catching up the lime and soda ash samples after about three hours. These small experiments were only intended as a comparison between the various chemicals and are not to be compared too closely with the practical results on a larger scale.

(c) It was found that for normal conditions of the raw water, no matter what other coagulants might be used, there was a fairly definite optimum dose of alumina required to give a satisfactory filtrate. Decreasing the dose below this point gave disproportionately bad results, while increasing it much above this point did not give very greatly improved results. For six hours settlement this dose was about 0.7 gr/gal. and for four hours, it was about 0.8 gr/gal.

Somewhat higher doses were used with the very turbid waters, but as the bad conditions generally occurred in the small hours and lasted for a few hours only, I cannot say whether the actual alumina doses given to the turbid waters were very much higher than necessary or not, but I am fairly certain, in the light of results obtained from the Paterson Plant, that they were on the high side. I hope to deal with this point later when discussing the running of the plant now installed.

The doses of soda ash and lime were generally half the Alumina dose or less, and it appeared that provision for a maximum dose of just over half the alumina dose would be adequate. Sodium aluminate was never needed in doses above 0.1 gr/gal. and usually a slight trace produced marked results. The maximum doses advised for the plant after completion of these tests were :—

Alumina	5	gr/gal.
Lime	3	,,
Sodium aluminate ..	0.1	,,

It was decided the lime, although more inconvenient to use than soda ash, would be preferable as it would probably be required for addition to the treated water also.

The *Penell-Wylie* upward flow filter mentioned above, and details of which are shown in the drawing is rather interesting. It was not possible to give as detailed a test as might have been wished, but the results generally showed that, with careful control of the chemical dosage, this filter could give results equal at any rate to the other experimental filters.

Considerable trouble was experienced at first with the grade of sand provided. After replacing some of this with a finer sand the results were much improved, but there was no opportunity of testing this filter with a very turbid water.

In this filter water enters at the bottom of the sand bed, and the makers claim that a large proportion of the sediment is deposited in the cone shaped lower portion of the filter. The water then rises through the bed and is carried off by a trough round the edge. To wash the filter, the inlet is closed and a sludge valve at the bottom of the cone suddenly opened. It is claimed that the resulting partial vacuum caused in the sand bed is most effective in cleaning it and I believe that filters of this type are dealing effectively with very heavily charged waters at Home, particularly water polluted by trade waste. Filters of this type are installed at the Singapore Swimming Club.

The rate of flow through the filter is naturally low to prevent disturbance of the sand and with this filter it was only 36 gal. per sq. ft. per hour. The head loss while working is very little, a matter of inches only. While this downward wash seems theoretically effective, I am not entirely convinced that it is capable of removing completely a very fine floc of the type often obtained with "normal" Ayer Hitam water which might penetrate some distance into the fine sand above the lower courses of gravel. There is no violent agitation of the filter media as with the more usual type of filters to remove this deposit, only the downward pull caused by the opening of a fairly large scour valve. Only experiments carried out over a long period could show whether this filter does gradually choke up and I should be grateful if anyone here could give me more information on the matter.

Settling tanks, chemical apparatus

I am afraid the information obtained from these experiments is not as full as it might be. No attempt was made for instance to discover the optimum pH value for obtaining a good filtrate with various conditions of the water, but the main object was, as stated before, to find out what chemicals were needed in the final plant and what the capacities of the dosing apparatus should be. This was done and the results incorporated in the instructions sent to tenderers, firms being asked to quote for the following maximum doses :—Alumina 5 gr/gal., lime 5 gr/gal., sodium aluminate 1.0 gr/-gal. On the advice of the Paterson Engineering Co., these maximum doses have subsequently been modified to 1.3 gr/gal. for lime and 0.2 gr/gal. for sodium aluminate, the reduced doses enabling finer adjustments of the proportioning apparatus to be made.

View of filter house from hill above filters

The question of installing a sterilization plant was also considered but it was finally decided in view of the favorable bacteriological reports, not to include this under the contract. Provision has been made for adding chlorine or chloramine at a later date if desired.

Ozonization was also considered but it is not a practical proposition for a plant of this size the initial cost being very large, about 20 times that of a chlorine apparatus.

From the preliminary experiments we now come to the finished plant itself.

The plant has been constructed inside the original settling chambers, which were approximately each 60-ft. square by 18-ft. deep. One of these has been retained as a sedimentation chamber giving about four hours settlement, while the other has been adapted to contain the filters, plant, and chemical house.

The unfiltered water enters the plants through an 18-in. pipe controlled by a butterfly valve which shuts off as the level of water in the filters rises, preventing the tank overflowing should the filters not be taking the full load.

The water first flows downwards through a vertical flume into the cone shaped preliminary settling tank, where the makers claim, much of the heavier matter is deposited. It then overflows into a trough surrounding this tank and is led over the main inlet weir to a distributing channel and thence to the main sedimentation tank. Lime can be added both in the vertical flume and at the weir; alumina and sodium aluminate can be added in the collecting trough round the preliminary settling tank.

A bypass main has been provided so that after passing over the weir water can be led straight to the filter inlet channel.

The main sedimentation tank contains over and under baffle walls, adaptions of the old training walls. The bottom has been converted to ridge and furrow formation with perforated sludge pipes along the bottom of the furrows. A gangway is provided to allow the attendant to operate the sludge valves.

From the sedimentation tanks the treated water spills over the lip of a collecting trough and is led to the five filters. Provision has been made for the addition of lime and alumina in this channel if required.

There are five filters of the rapid gravity type, each capable of passing 30,000 gallons per hour if necessary, the normal rate of flow being 25,000 gallons per hour.

The filters are cleaned by air scour followed by upwashing with filtered water. All controls can be operated from the platform inside the house, except for the rate of flow controllers which are situated below in the engine room and which I propose to deal with in more detail later. Each filter is provided with a loss of head and rate of flow gauge. Wash water pumps and air compressors are

provided in duplicate, a large air receiver being provided to allow of small compressors being used.

A clear water tank of about 56,000 gallons is provided below the filters and also serves as a water reservoir from which the pumps draw. From this the filtered water flows via a " chlorination chamber," provided to allow of sterilization at a later date if required and where a final dose of lime may be added, through an 18-in. main to the reservoir.

Two separate stores are provided in the filter house, one for alumina and sodium aluminate and the other for lime, and overhead runways have been provided to enable one man to charge the dissolving tanks without difficulty.

Alumina and sodium aluminate are dissolved in duplicate concrete solution tanks and led through rubber hose to the automatic proportioning apparatus in the office. This apparatus consists in each case of a tank the level in which can be regulated as required by a ball valve with an adjustable lever. The discharge through an orifice in the bottom of this tank is regulated by a thick vertical tapered needle. The needle is raised or lowered from an overhead spindle controlled by a float in a chamber connected to the upsteam side of the main inlet weir. The position of the needle is thus regulated by the level of water flowing over the inlet weir and the taper is so made that the flow of chemical solution is always proportional to the flow of raw water. The head of water above the orifice, and of course the solution strength, can be adjusted to give any dose required, the automatic gear maintaining that dosage whatever the variations in the main flow. The apparatus is simple and effective, the only drawback being that the level in the ball valve tank actually varies some 10 per cent according to the level in the solution tanks. This could of course be easily remedied, by a floating draw-off arm in the solution tank for instance, but as an attendant is constantly on the premises it is quite simple to make an occasional adjustment of the ball valve to keep the level constant.

The method of adding the lime is different. A mill with a revolving tray is provided in the store to dissolve the lime, the resulting solution flowing to a container on the floor below.

This container has a horizontally revolving stirrer to which cups are attached, thus delivering a supply of milk of lime to a tray from which it flows into the oscilameter or proportioning apparatus. The latter consists principally of two wedge shaped buckets, mounted on a spindle and each divided longitudinally into equal parts. The smaller pair of buckets is for the lime solution and the larger for water. A water supply is admitted through an adjustable rectangular weir, the sill of which is level with the sill of the overflow from the clear water tank, the quantity of water passing over this adjustable weir being thus proportional to the flow of filtered water from the plant. When one half of the water bucket is full it over balances and partially rotates that spindle discharging the water and also the lime from the lime buckets. The other half of the water bucket then fills and tips the spindle and buckets back again, and so on, each tip discharging a measured quantity of lime solution, the number of tips per minute being adjusted by means of the weir to give any required dose. The apparatus is rather difficult to describe without a drawing, but it is very simple as no doubt you saw when you inspected it.

The milk of lime and water discharged from the buckets flows into a suction tank provided with a make up supply of water through a ball valve, and is thence pumped to the office where four cocks and funnels allow it to be distributed to the various dosing points as required.

A " fluxograph," or flow recorder is provided in the office giving a chart record of rate of flow, the total quantity passed, and the actual rate of flow at the moment.

The plant was first put into operation on December 18, and has been providing filtered water ever since, but as it was not ready to be handed over to the Municipality until the end of February there has only been a very short time in which to experiment on the various combination of doses, and the following remarks are subject to reconsideration in the light of future experience.

Generally it has been found easier to obtain a good filterate from a very turbid raw water in which a floc forms easily over a fairly wide range of chemical dosages, than with a fairly clear " normal " water when a slight misadjustment of the dose may result in no floc being formed and the fine colloidal clay passing through the filter sand. Added to this, the pH value of the raw water frequently changes without any apparent reason, so that it is necessary to test and examine the treated water at frequent intervals to avoid obtaining a bad filtrate.

The experimental results have been borne out in that the addition of lime to the " normal water prior to filtration has a detrimental effect on the filtrate, but the use of lime with a turbid water is very necessary to obtain good results.

New Railway Line in Manchoukuo

SIMULTANEOUSLY with the formal operation on September 1 of a newly constructed railway between Ssupingkai and Hsian, a distance of 82.5 kilometers, a portion of the present Mukden-Kirin line will form with the new line an independent railway route, according to an announcement by the General Direction of Manchoukuo State Railways.

This route is to run from Ssupingkai on the S.M.R. trunk line to Meihokou, a town on the Mukden-Kirin line. Hence, it will be named the Ssupingkai-Meihokou line with a length of 156.3 kilometers, it is declared. This, it is explained, has been considered necessary to facilitate the transport of coal and farm produce from the Hsian district.

Hitherto, these goods have been sent by rail far away to Kirin or Mukden for distribution, but the creation of the new line between Ssupingkai and Hsian makes possible the transhipment of these commodities by the S.M.R. trunk line by way of Ssupingkai. This will greatly speed up and economize the shipment of Hsian coal and farm products, it is stated.

Officials of the General Direction further announce that the projected Ssupingkai-Meihokou line also is destined to play an important rôle in the exploitation of the wide Tungpientao area which has now been nearly purged of banditry through efforts by Manchoukuo and Japanese troops.

Work on the construction of the new line from Ssupingkai and Hsian, a town known for its colliery, was started by the General Direction office established by the General Direction in April, 1934. First, the construction office established by the General Direction proceeded with the erection of bridges, tunnels and other engineering works. The progress of the task was greatly hampered by the frequent occurrence of flood disasters, but the construction office through co-operation among its entire staff succeeded in finishing the first stage of the work.

Towards the end of October, 1935, the laying of rails was commenced simultaneously from Ssupingkai and Hsian and completed on December 15. Since that time, the line has been under informal operation. This railway runs through mountainous districts noted for their scenic beauty like the present Mukden-Kirin line. The principal towns on the line are :

Chief Towns Along Line

Pingtung : Located at a point 7.1 kilometers from Ssupingkai. Pingtung at present is a small town inhabited chiefly by farmers.

Hafu : A village 12 kilometers from Pingtung. Hafu is commonly called Liuchiatun or Fafutun by the natives. It consists of only about 30 farm-houses, but with the inauguration of the new line, its population will rapidly increase, it is believed.

Shihling : Shihling is a town with a population of about 3,000. It is located at a point 15.8 kilometers from Hafu. It is an important town as a local distributing center of farm products.

Pingkung : This is a walled town 24.2 kilometers from Shihling and with a population of 3,500. Surrounded by fertile plains suitable for rice-growing, Pingkung bids fair to be one of the most important towns on the new railway line. Kaoliang is the principal farm product of this district.

Paichuan : Located at a point 12.1 kilometers from Pingkung. Paichuan has a long history, the town having been created in the era of Kanghsu. With fertile, hilly farms in the vicinity, the town is known for its production of soya beans (2,200 Japanese koku yearly), Kaoliang (3,500 koku), wild silk and other farm products. It is the biggest distributing center of farm produce on the line. The distance from Paichuan to Hsian is 11.3 kilometers.

Waukesha Motor Company Expands Export Activities

With the appointment of Mr. M. E. Nicklin as Export Manager, a new department of Messrs. Waukesha Motor Company is created to handle the many intricate and important details of an export business. It is the outgrowth of the Export Division which Mr. Nicklin has directed for several years.

As a result of the general expansion in all American export trade, the past year has seen the export business of the Waukesha Motor Company increased, and there are to-day many foreign inquiries for representation throughout the European countries that indicate a bright prospect for future expansion in this field. To take advantage of this opportunity, Mr. Nicklin is sailing from New York direct to Genoa, Italy, on July third for an extended trip throughout Southern and Central Europe. He will visit Albania, Greece, Austria, France, Belgium, Holland, Spain, Germany, Portugal, and England before returning.

In several of these countries the Waukesha Motor Company is well known and their products are in wide use. The oil fields of Roumania have been an especially active market for some time. Representatives in Greece and in Spain have introduced Waukesha engines to the agricultural industry while the fuel research engines have found their way into the scientific and research laboratories of every civilized country.

Of greatest importance in the export field are the developments that have been made in oil engines for both industrial and automotive service. Long leaders in fuel research problems and the development of engines to fit fuels of this kind as found in foreign lands, the Waukesha Motor Company's Comet Diesel engines and the Hesselman oil engines have a particularly wide appeal in these European markets. Everywhere oil engines have come to the front in the past five years but nowhere have they so nearly captured the heavy duty vehicle field so much as in Europe. Practically no modern trucks or buses are gasoline driven any more. Engines of the Hesselman and Comet type have been exported to all of these countries and a very important part of the future export business is expected to be of these two types.

Mr. M. E. Nicklin

Mr. M. E. Nicklin, a native of Pennsylvania and a graduate of Penn State College, entered the employ of the Waukesha Motor Company in January, 1926, as assistant to Mr. J. E. DeLong who at that time was in charge of Oil Field Sales promotion. In 1930 Mr. Nicklin succeeded Mr. DeLong as chief of the Oil Field Division, and four years later became Assistant Sales Manager. In addition to his oil field activities, in 1927 he became Director of Export Sales so that his wide experience with the Company in both domestic and export fields led to his appointment as manager of the Export Department. He has a wide acquaintance with foreign markets and with foreign representatives, many of whom have visited the Waukesha plant. He plans, on his return, to make other extended trips to the Orient and Far East where there is a steadily increasing demand for engines of the type built by the Waukesha Motor Company.

The Ujigawa Electric Power Company of Osaka

(*Continued from page 358*)

1923—Output of Fukuzaki Steam Power Plant increased to 40,000 kilowatts.
Permission obtained for the Fourth Hydro-electric Development (i.e. Ohmine Power Plant of 16,000 kilowatts); the work started.

1924—Kiyoshi Kimura, Esq., retired from his position and Yasushige Hayashi, Esq., succeeded. Second Hydro-electric Development completed.

1925—Gold bond issues for $14,000,000 floated in the United States by a syndicate headed by Messrs. Lee, Higginson & Co., Boston, etc.; Removal of Head Office to Osaka Building, the present office.

1926—Construction of Kizugawa Steam Power Plant of 60,000 kilowatts began. The Fourth Hydro-electric Development completed.

1927—Acquisition of Hyogo Electric Tramway Co. and Kobe-Himeji Electric Railway Co. running between Kobe and Himeji cities; capital increased to Y.92,500,000.
Kizugawa Steam Power Plant completed.

1928—Through traffic service between tram and railway lines commenced operation.

1929—Neyagawa Sub-station completed; a remarkable improvement of transmission system by concentrating power from all important sources at this new station.

1930—The foundation work for the Suriko Power Plant, with a capacity of 7,758 kilowatts within Yamato territory, was completed, and erection work is on the way to completion.

1932—Suriko Power Plant completed.

1933—Electric Tram and Railway Department's business concession and its properties were sold and assigned to the Sanyo Electric Railway Company, Ltd.

1934—According to a resolution passed at a general meeting of shareholders held on April 10, the First Domestic Mortgage Bonds (the aggregate principal amount of One hundred million yen) shall be issued dividing them into several series.

1935—Construction of Nagatono Power Plant of 15,000 kilowatts began.

The authorized capital of the Ujigawa Electric Power Company is Y.92,500,000. It furnishes electric power amounting to 722,714 horse-power and 441,533 electric lights in eight prefectures, serving seven cities and 241 villages. It operates 23 power plants, 62 sub-stations and 17 switching stations. The officers of the Company are: President, Yasushige Hayashi; Vice-President Senzaburo Kageyama; Managing Director, Kazue Yamasaki; Directors, Messrs. Yasuhige Hayashi, Senzaburo Kageyame, Kazue Yamasaki, Matazo Asami, Jun Noguchi, Senzo Nagai, Kunijiro Kishi and Shiro Ishizawa; Auditors, Baron Kishichiro Okura, Tadao Okazaki and Junichiro Matoba.

Locomotives of the Malayan Railways

(*Continued from page 365*)

Other exceptional mileages about the same time include 12,510 miles run by engine No. 245 in October, 1934, and 13,267 miles by engine No. 241 in January this year.

These remarkable locomotive performances have not, it is believed, been equalled by any meter-gauge railway throughout the world, and demonstrate the efforts which are being made to provide cheap and efficient railway transport in Malaya.

Philippine Gold Mining

By C. M. EYE, former Superintendent of Benguet Consolidated, in the Colorado School of Mines Magazine

GOLD mining as an organized industry in the Philippine Islands, was practically non-existent prior to the American Occupation in 1899, and for several years after. In 1903 Congress provided a mining code which permitted location of mining property. There followed a period of active prospecting and location, mostly by men from Western United States, who had come to the Islands as members of volunteer regiments. Owing to the primitive conditions existing and to lack of financial backing, development progress was very slow: Practically no capital from abroad was available and local capital for mining investment was scarce. Such milling plants as were built were small and light, and depended solely on amalgamation for gold recovery.

The first mill in the Benguet District was of this type: Built by Jack Hartwell of Phillipsburg, Montana, in 1903, it consisted of three stamps of 265 lb. each, working in a mortar with sheet iron sides, with a few feet of copper plate for amalgamation. Hartwell died of smallpox in the epidemic which swept Benguet in 1904, and the plant was removed.

At about this time a portable prospecting stamp mill of all iron and steel construction was placed on the property of the Eastern Mining Co. at Aroroy, Island of Masbate, but for several reasons was not operated long. In 1905 Messrs. Peterson, Clyde and Reavis built a mill on the Comote property in Benguet. It consisted of three stamps of about 500 lb. each, working in a cast iron mortar, with a few feet of silvered copper plate; no crusher was furnished, but this small mill worked successfully for several years on calcite and manganese ore, soft and mostly fine.

In 1906 the first plant in the Islands to employ cyanidation as well as amalgamation was erected by the writer on the property of the Benguet Consolidated, at Antamok, Benguet. The treatment consisted of breaking to stamp mill size in a 7 × 10 jaw crusher, reduction to 40 mesh by three 1,050 lb. stamps working in individual, triple discharge mortars, amalgamating on a silver plated copper plate 12-ft. in length, elevation, and classification of tails into sands and slimes, the former going for leaching to six 50-ft. tanks and the slimes to waste. There were of course, the storage, sump and solution tanks and zinc boxes which constituted a necessary part in such a plant. Later, a slimes treatment plant was added and a Wilfley table, the former to save the high values which were in the slimes and the latter to remove sulphides from the sands prior to leaching. At a still later date, a 12-ft. Ridgeway filter was installed to reduce soluble losses in slime treatment. This filter was in operation a very short time when the major portion of the plant was lost in a typhoon and flood, on November 28, 1909. A somewhat similar plant, built several years before by the Bua Mining Co. just below the Consolidated Camp was badly crippled by the flood, and in 1910 was dismantled.

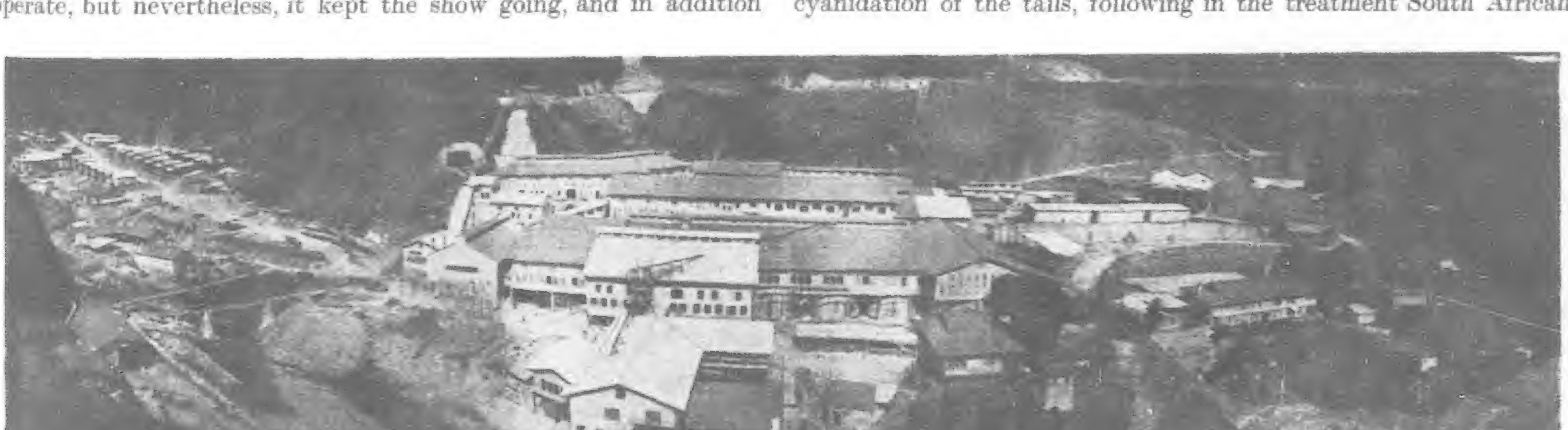
It is apparent that the first Benguet Consolidated mill was too complex, and involved too many operations to be very easy to operate, but nevertheless, it kept the show going, and in addition to yielding some profit, enabled the development of the mine from practically no reserves to begin with, to some 18,000 tons of around $17 gross value per ton in sight at the time the washout occurred. The mill operation also furnished much information regarding treatment which was of considerable value later, when a new mill was called for.

Meanwhile considerable prospecting and development of claims was going on elsewhere in the Islands, notably in the Paracale District in S.E. Luzon, and in the Aroroy District, Island of Masbate. In Paracale the development was mainly of placer deposits, which, while not so very extensive were quite rich, enabling them to be worked profitably for several years, even though the dredges were small and the dredging conditions difficult. Several larger dredges were built in the United States for properties in this and neighboring localities, but it did not take long to exhaust the deposits, and production figures dropped to a low point. At this time, considerable interest is being shown in placer deposits, especially on the Island of Mindanao, so there may be a revival of production from this source.

By 1910 favorable developments on the Colorado property had reached the point where a milling plant was fully warranted, so in 1911, the writer who was in charge of this property built a mill of 100 tons rated capacity—the first in the Islands to employ fine grinding in solution, and cyanidation throughout. The equipment consisted of a jaw crusher and twenty 1,050 lb. stamps for preliminary reduction and two 5-ft. by 16-ft. tube mills for fine grinding, two Pachuca tanks each 12-ft. by 45-ft. for agitation, primary and secondary thickeners for counter current decantation, steel zinc boxes for precipitation and two Oliver filters for final washing (These last were later replaced by a Moore filter). The ore consisted mainly of quartz and manganese oxide with some calcite, with the gold very fine and very free. It was therefore very amenable to cyanidation, as high as 80% of the values often going into solution by the time the pulp left the grinding circuit.

At the time of starting the mill, there was in sight in the mine, 118,000 tons of ore of better than $14 gross value per ton. This plant was profitably operated for a number of years, though it later became necessary to discard the stamps and to convert the tube mills into ball mills, because of changes in the character and grade of the ore from the lower workings in the mine. The original investment in this enterprise was not much in excess of $300,000, and the total production was reputed to be over $3,000,000, from which a number of substantial dividends were paid before the final shutdown and dismantlement of the plant. Recent announcements have been made of the intention of the present owners to build a thousand ton mill on the property to handle low grade ore believed to remain in the mine.

At about the time that the Colorado mill was under construction, a milling plant was built on the Headwaters mine in Benguet by C. T. du Rell, '95. As I recall, it employed amalgamation with cyanidation of the tails, following in the treatment South African



Balatoc—It took a vast expenditure and many years of effort before this mine attained its present high rank among the world's great gold mines

practice of the time. The equipment consisted of a coarse crusher, ten stamps, amalgamating table, conical tube mill for fine grinding the tails and a number of conical bottom steel treatment tanks, and finally a 14-ft. Ridgeway filter. I am not at all certain as to the method followed in the treatment, as I never saw the plant in regular operation. It was run for a time by the owners, and later by successive lessees from time to time, until about 1926 when the Itogon Mining Co. bought most of the equipment, and removed it to their property. When the mine was reopened by Baguio Gold, a new mill was built in a much more advantageously situated location, not previously available.

Soon after the equipping of the Colorado mine with a mill, the neighboring Syndicate property (formerly the Eastern) was supplied with a 150 ton plant which also used fine grinding and cyanidation. The equipment consisted of a washer for removal of clay, a gyratory crusher, ball and tube mills for reduction, Symmes agitators and a counter current series of tanks for treatment, zinc boxes for precipitation and Kelly filters for final washing. This plant, enlarged from time to time, was operated at a profit for many years by the Syndicate Mining Co. but was finally sold with the mine to Mr. Paul Schwab, who with Ben. Berkenkotter operated it profitably for many more years—in fact I believe it is still in operation, and there is now talk of enlarging it to 1,000 tons per day to handle large reserves of low grade ore.

In 1915 a new plant of a rated capacity of 60 tons per day, was erected on the Benguet Consolidated property by the writer. This plant provided treatment by fine grinding (in solution), and cyanidation, the equipment installed consisting of a 9 by 12 jaw crusher, ten stamps of 1,050 lb. each, one tube mill, 6-ft. by 10-ft. three Dorr agitators and five thickeners, one Dorr Duplex classifier working in closed circuit with the tube mill, and zinc boxes for precipitation. Later, when the need was felt for greater treatment capacity, a line of Trent equipment consisting of one agitator and three replacers was installed, but was later discarded in favor of more Dorr equipment. An additional tube mill, 6-ft. by 8-ft. was added in the course of time and an Oliver filter was installed in 1917 to reduce soluble losses. Other changes and additions were made from time to time, the stamps being finally replaced by ball mills, the smaller tube mill converted into a ball peb. mill, zinc box precipitation replaced by press precipitation in conjunction with the Crowe process, more classifiers added (including two bowl classifiers) and more Oliver filters (until at present there are in operation six of these, all 11½-ft. by 14-ft.) Several additional ball mills have been added, and the old tube mill discarded. The capacity has thus been brought up to 800 tons per day, after the addition of flotation apparatus to handle the natural slimes of the ore, but the line of treatment adopted in 1915 has not been materially changed except for the flotation feature just noted (which increased the mill capacity by 200 tons per day). Never since the mill started in 1915 has it been short of ore, except for one short period when hoisting was stopped by reason of a mine fire. The property has produced close to $25,000,000 and paid regular dividends since September 1916. As for ore reserves, the 1924 report gives the estimate of 981,905 tons of positive and probable ore, of an average value of $9 per ton, on the old basis of $20.67 per oz. (Figured on the present price of $35, the total gross value of reserves is in excess of $15,000,000.)

In 1926 a milling plant was put into commission on the Itogon property in Benguet. It was not much of a mill, consisting largely of such second hand equipment as could be had locally, but with improvements and enlargements from time to time, it has maintained continuous operation ever since. With handicaps of lack of capital and of a rather low grade of ore, the pull to reach a profitable stage was a long hard one, but with capable management and the advantage of the present high price of gold, it now ranks as one of the more successful mines of the District. The annual production climbed from a little over $100,000 in 1927 to over $800,000 in 1933, the total up to the end of that year being $2,635,-664.43, while the production in June of this year was $102,081, from 10,030 tons milled. Antamok Goldfields, which is crowding Itogon for third place in production handled 12,000 tons in June with about the same recovery, began operations much later, but has not been very successful.

The most important mine in the Islands, however, is the Balatoc, a mere prospect in 1926, but now one of the big mines of the World. It was taken over by the Benguet Consolidated in 1927 and equipped with a mill of 100 tons nominal capacity. Its growth since then has been spectacular. The grade of the ore has maintained a high average in value, the ore bodies are strong and consistent and the ore is treated with no great difficulty and with high extractions. The capacity of the mill has been increased several times to keep up with the mine, until at present it is handling 1,200 tons of $9 grade per day (old basis)—and the mine is still leading, with reserves constantly increasing. At the end of 1934, reserves of positive and probable ore totalled 1,134,883 tons of an average grade, on the old price for gold, of $10 per ton. The output per month for this year has been around $500,000 at $35, per ounce for gold. The line of treatment, while somewhat similar to that of Benguet, is more complex and difficult, requiring finer grinding, and longer contact. Step filtration with repulping and re-agitation, has featured the treatment from the start. Space does not permit me to undertake a detailed description of the plant, nor to discuss the treatment further.

Encouraged by the success of Benguet, properties have been equipped and brought into production within the past few years, notably Antamok Goldfields (previously mentioned), Baguio Gold, handling around 4,000 tons per month with recovery of about $35,000, Demonstration, milling about 5,000 tons per month, with an output of about $40,000, Benguet Exploration with about 2,000 tons milled per month and recovery of about $17,000, Suyoc Consolidated (in Northern Luzon) with output of about $30,000 per month from 2,500 tons milled, United Paracale (in S.E. Luzon) with 2,500 tons milled per month and a yield of around $30,000 and Ipo (in Bulacan), whose production has been somewhat uncertain and varying for some time past, owing to shortage of payable ore. The mill has a capacity of 150 tons per day but has not been operated to capacity lately. Gold River, in Benguet, was equipped with a very complete mill early this year, but proved to be a flop, due to lack of payable ore in quantity sufficient to keep the mill going.

On the whole, however, the industry is in a very thriving condition, and production, which climbed from $3,700,000 in round numbers in 1930 to $12,000,000 in 1933, and which has exceeded $7,500,000 for the first half of 1934, should reach (and perhaps exceed) $16,000,000 for 1935, making due allowance for normal increase from the plants already working and some additional from two plants now under construction—The Salacot in Bulacan Province near the Ipo of a rated capacity of 200 tons per day and the mill which is being placed on the Cal Horr property of Benguet Consolidated, in Benguet, of 150 tons capacity. Both of these plants should be in commission by the end of September; other plants are projected on properties now being developed. It is not an unreasonable assumption, therefore, that there is likely to be further growth of the gold mining industry in the Islands for some years to come.

New Japanese Air Routes

Four new Japanese air lines, aggregating 938 miles in length, will be opened for service on October 1 by the Japan Air Transport Company, with the aid of part of the Communication Ministry's recent Y.1,920,000 appropriation, according to the *Asahi*. In addition, several others will be inaugurated next spring, including the long-projected Tokyo-Sapporo service and one from Osaka to North Korea.

The four to open on October 1 are the Tokyo-Niigata line by way of Nagano, covering 232 miles in two hours; from Osaka to Nagano by way of Toyama, traveling 310 miles in three hours; from Osaka to Matsue by way of Tottori, 213 miles in one hour and 40 minutes; and from Osaka to Kochi, via Tokushima, covering 183 miles in one hour and 50 minutes. The aerial link between Tokyo and Sapporo, via Sendai and Aomori, is scheduled to open on April 1. A service between Osaka and Seishin, crossing the Japan Sea from Yonago, Tottori Prefecture, and a "Kyushu belt line" are also expected to be opened during the next fiscal year.

The lines, which will be operated by the Japan Air Transport Company, will be provided with landing fields, beacon lights, radio stations and other facilities by the Communications Ministry. The company is preparing to make a series of test flights over the 579 mile Tokyo-Sapporo line this fall and an aerial network over Formosa may be inaugurated early next year. A new reserve air field will soon be opened at Osaka to assist in operation of the new lines.

Production in Japan of Natural Indigo is Holding its Own

Indigo growers harvesting their crops

THE plant *Polygonium tinctorium* (Japanese, *Ai*) has since early times furnished indigo to many countries in the Far East, says Herbert Leopold in the *Dyer*. It belongs to the genus *Persicaria*, like the common kinds of knotweed. From a stout fiber-root, it puts forth many round, leafy stalks, 30-50 cm. high, at whose joints or nodes the oval, pointed leaves, and afterwards, the blossom-spikes are developed. The blossoms are odorless, of a red color, and very similar to those of several other kinds of *Polygonium* in their appearance and structure. They appear in August and September, and the harvest generally takes place before they are fully developed. Chemical investigation has shown that the indigo chromogen, indican, is confined to the leaf-parenchym, in cells, and that the stems and blossoms are devoid of it. The method of cultivating and handling the plant is carried out in accordance with this fact.

The dyer's knotweed is by far the most important Japanese dye plant. Despite the advent of synthetic colors it is still cultivated over a wide stretch of territory. The seed is seldom sown directly in the fields, but mostly in beds from which shoots are taken and set out in rows. When the stalks are about 30 cm. high, they are cut off with the sickle, close above the ground. Their upper parts, which have the most leaves, are justly considered of the greatest value. These, with the leaves, are cut off from the lower parts of the stalks, which are dried and then burned for the sake of a highly prized kind of ash (*Ai no hai*, ash of indigo) thus obtained.

The leaves are spread in the sun to dry before the house, frequently on the bare ground. They become a dull, dark green, and in this condition are put away in straw-rope sacks to await further treatment. This takes 70-80 days. It is a kind of fermentation, and has to be conducted with great attention and skill. The leaves, after being sprinkled with a certain quantity of water and thoroughly mixed with it, are then spread out and left 3-5 days under a cover of mats. The process is repeated 19-20 times altogether, and finally the leaves are put into a wooden mortar. Here in two days' time they are worked into a doughy mass of a dark blue color. From this balls are made, from the size of billiard balls upwards, and in this form the article appears in domestic trade. This is indigo as it is used for blue. A dark indigo brown, inclining to violet, is prepared from *Ai* with the addition of lime and *Aku*, the ashes of indigo-refuse.

Brooms are used to hasten the drying process

Once an Important Export

In the beginning of the Meiji Era (following the opening of Japanese ports to foreign trade) indigo-knotweed was a very important item on the export list of the young empire of the East, finding a ready market in England, Germany and France. Today, however, its use is almost confined to experimental purposes in the West.

In Japan, however, despite the importation and domestic production of synthetic dyes, which are much easier and cheaper to manufacture, the natural product still holds its ground in the domestic market, being regarded as an indispensable dye for certain kinds of cloth. For instance, *kongasuri*, a dark blue cotton cloth with white patterns, used for *kimonos*; *noren*, the traditional cloth used for shop-entrance curtains; and the *happi*, jackets worn by laborers and old-fashioned shop employees, are all dyed with the vegetable indigo, mostly produced on Shikoku Island. The Shikoku product is highly prized for its fastness, being resistant to repeated launderings.

Soviet Railway Double-Tracked

Completion of the double-tracking of the Trans-Siberian railway between Karimskaya and Khabarovsk for more than 2200 kilometers by prisoners under the direction of the Commissariat of the Interior has been announced in the Soviet press.

The task was begun in 1933 and all except a small section near Khabarovsk is now utilized.

The prisoner army excavated rocky hills and cliffs, built hundreds of tunnels, bridges and dams under the severest winter conditions. Two hundred engineers, including prisoners, directed the work.

The newspaper, *Gulock*, declared, " The majority of the workers had committed various crimes against the working class," for which they had been organized into a labor army, rigidly disciplined, which " transformed thieves, swindlers, murderers and saboteurs into sincere Soviet citizens. Such a school is possible only in our country."

Re-education of women prisoners under such conditions was declared particularly successful. Women were organized into " phalanxes " as were the men, and sometimes women were appointed directors of male groups.

Diesel Engines for the Propulsion of Fishing Vessels

By Dipl.-Ing. E. EHMSEN, VDI, Kiel

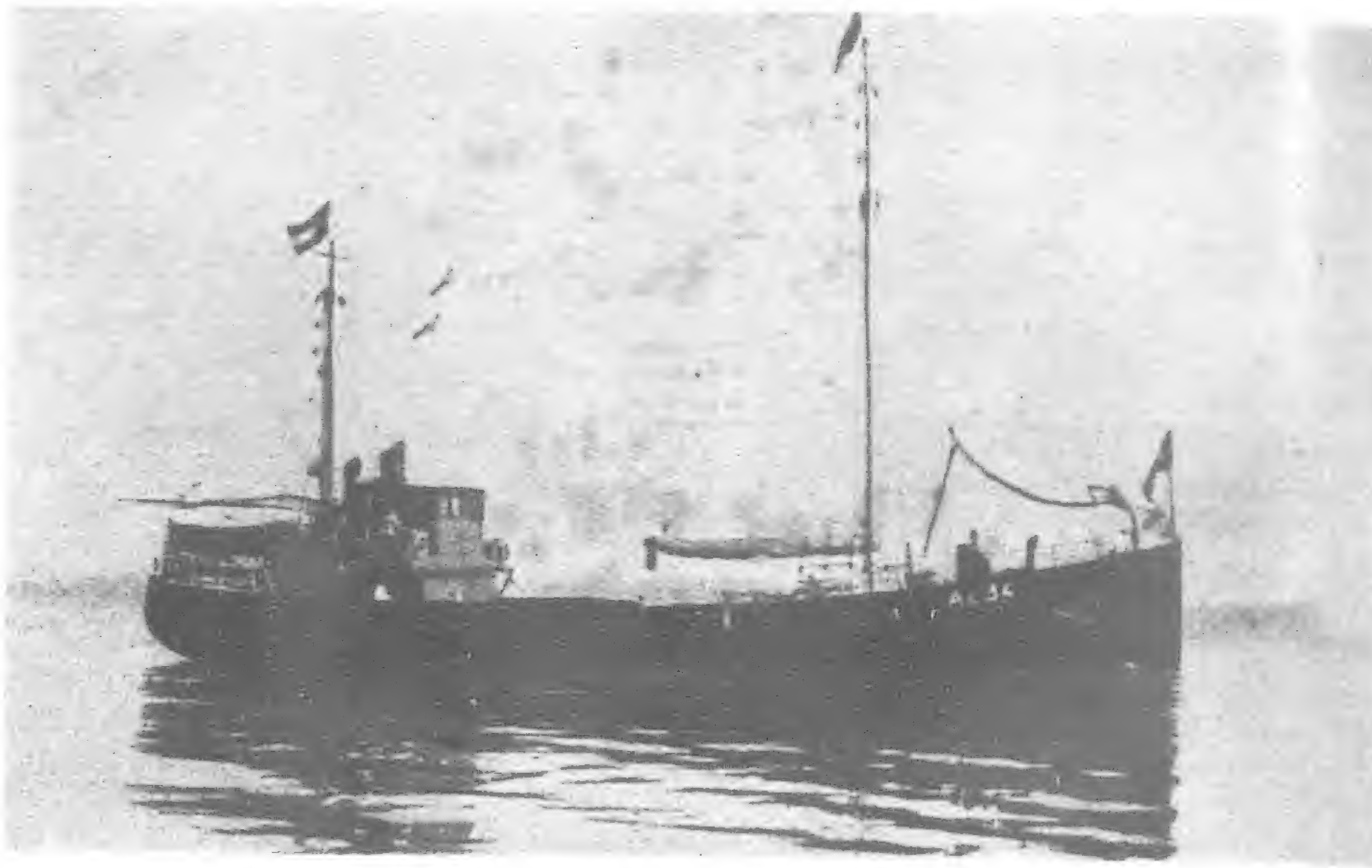


Fig. 1—Diesel-driven fishing smack

In 1902, the crude-oil engine was first tried out in a fishing vessel and in the following year, the first eight boats were equipped with oil engines. The results, however, did not prove very satisfactory, so that by 1910 there were in Germany but 211 engine-driven fishing craft. It was only after the advent of the Brons motor, which was built in capacities up to 30 h.p. and meant a large advance at the time, that the Diesel engine could be introduced rapidly into German coastal fishing, so that but a year later more than twice the number of fishing craft were run by oil engines than in 1930.

While, therefore, suitable oil engines had been found prior to the World War for driving coast fishing craft, no efforts were made at that time to run also the larger vessels of the deep-sea fleet on crude oil. Because of their simplicity, steam engines had proved very satisfactory for driving these ships and for the operation of the winches required in setting and pulling in the nets. Nevertheless, the opinion prevailed among experts even then that the Diesel engine, which had in the meantime rendered a good account of itself in marine service, was the only really good prime mover for larger fishing vessels, because the steam-power-drive had many disadvantages too.

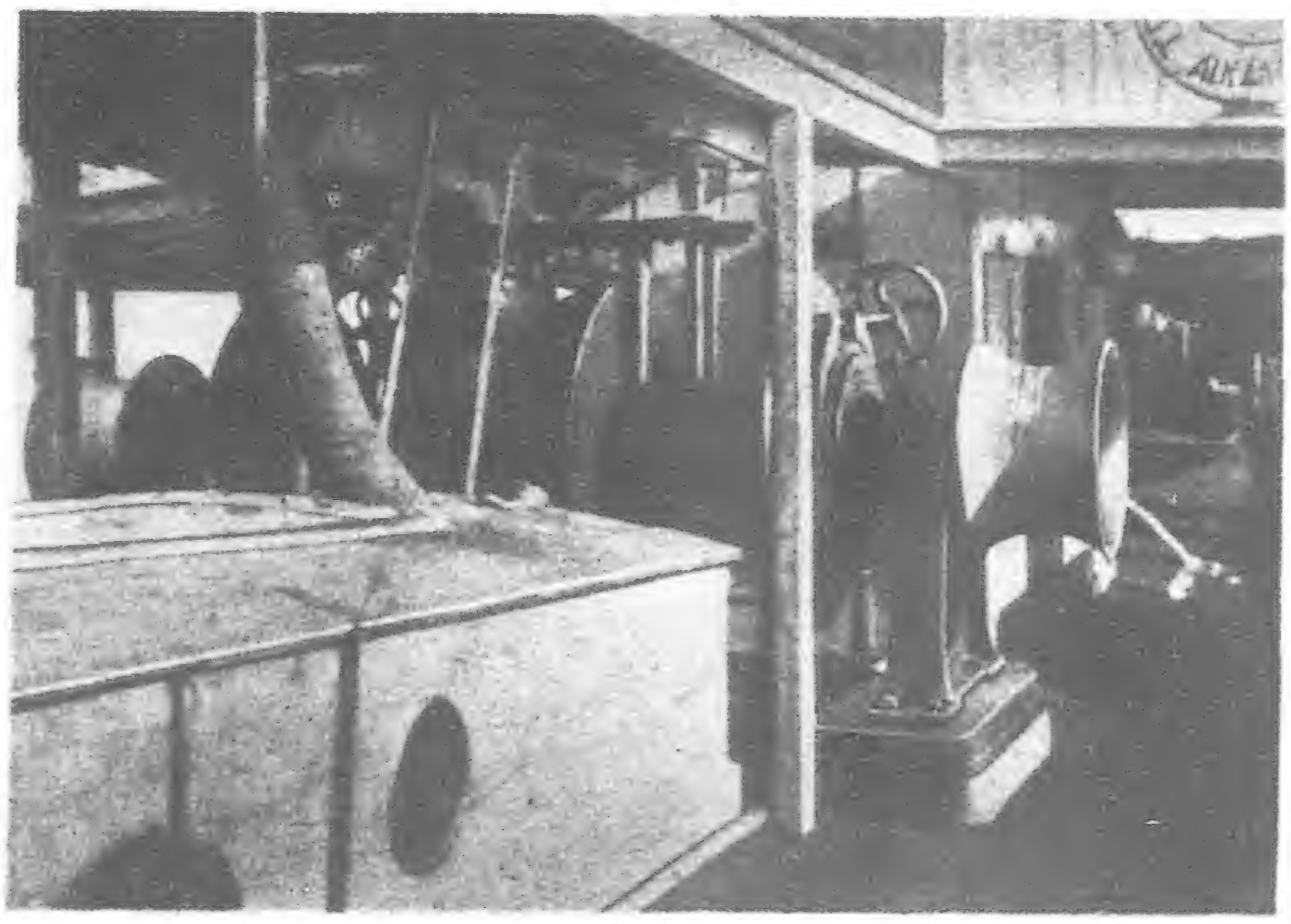


Fig. 2—Diesel-driven net winch on board of a fishing vessel

The steam engine and boiler in themselves occupy a good deal of space, and a considerable portion of the hold must be set aside for storing the fuel. As an instance, the coal required for running a steam plant of the size used in medium fishing craft takes up about ten times as much space, for the same cruising radius, as the crude oil needed for a Diesel plant of equal capacity. This comparison grows still more unfavorable for the steam engine when it is considered that crude oil can be stored in any available space in the ship, as for instance under the engine floor, and thence pumped to the fuel feed tanks, whereas coal requires space which is high up and therefore valuable. These drawbacks of steam engines have gradually led to the conviction that the Diesel engines are better suited as requiring less space, while at the same time they are completely able to perform the strenuous duty.

Nevertheless, another decade and a half were to pass before the Diesel engine was able to win through into deep-sea fishing craft, for it was not until 1926 that large fishing vessels began to be equipped with Diesel engines on anything like an extensive scale.

While the time is long past when the Diesel engine presented a problem for marine propulsion, there were difficulties in the way of using it for operating the net winch. Nets are quite expensive, their cost running to about one quarter of the total cost of the craft. For this reason, tearing of the nets must be avoided as far as at all possible, and this condition is more readily attained with steam or electrically driven winches than with Diesel drive. For this reason, very large Diesel-driven craft are still to-day equipped with electric winches or with auxiliary boilers and steam winches. In the case of small and medium-sized craft, on the other hand, good success has been attained by operating the net winch from the ship's Diesel engine.

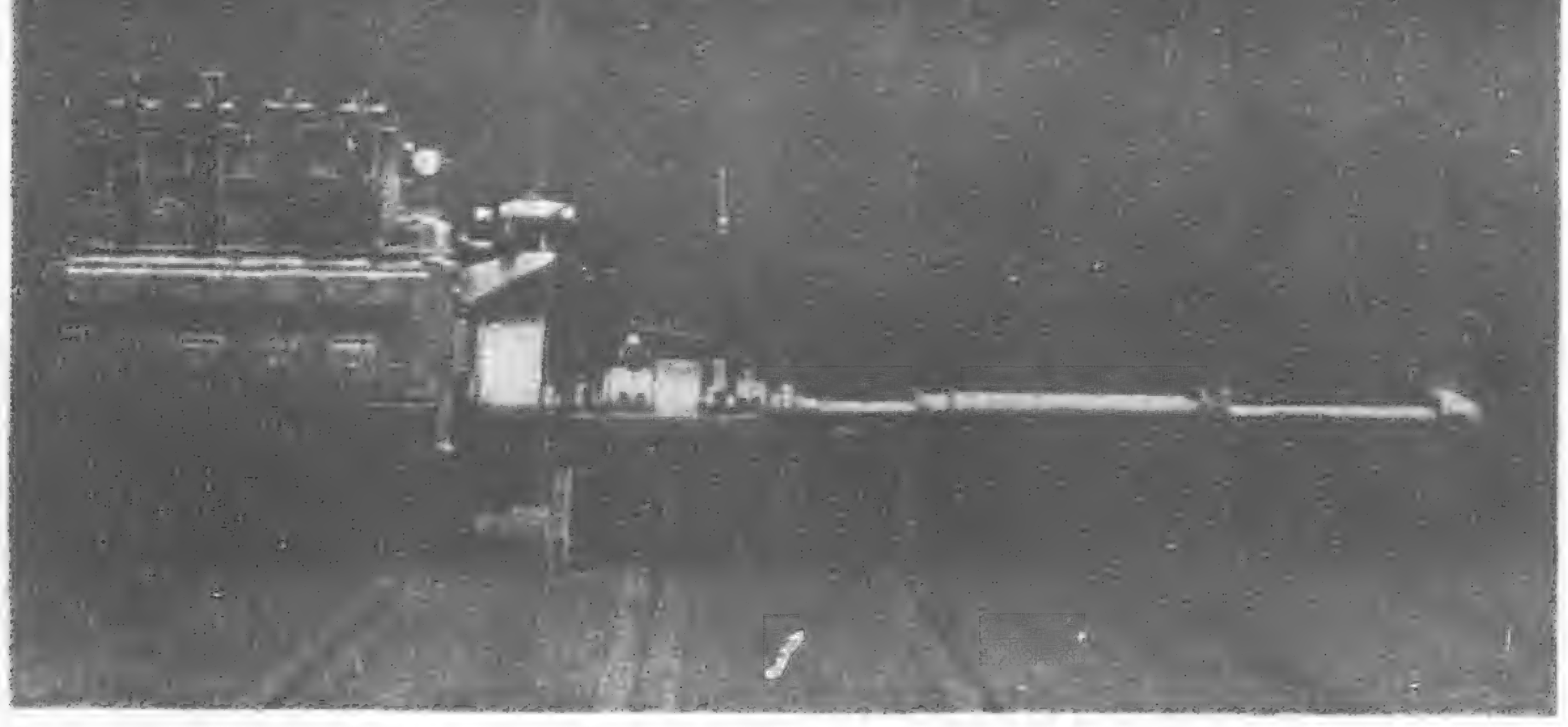


Fig. 3—Krupp Non-reversible four cylinder marine Diesel engine with reversing gear. The drag-net winch in driven from the flywheel

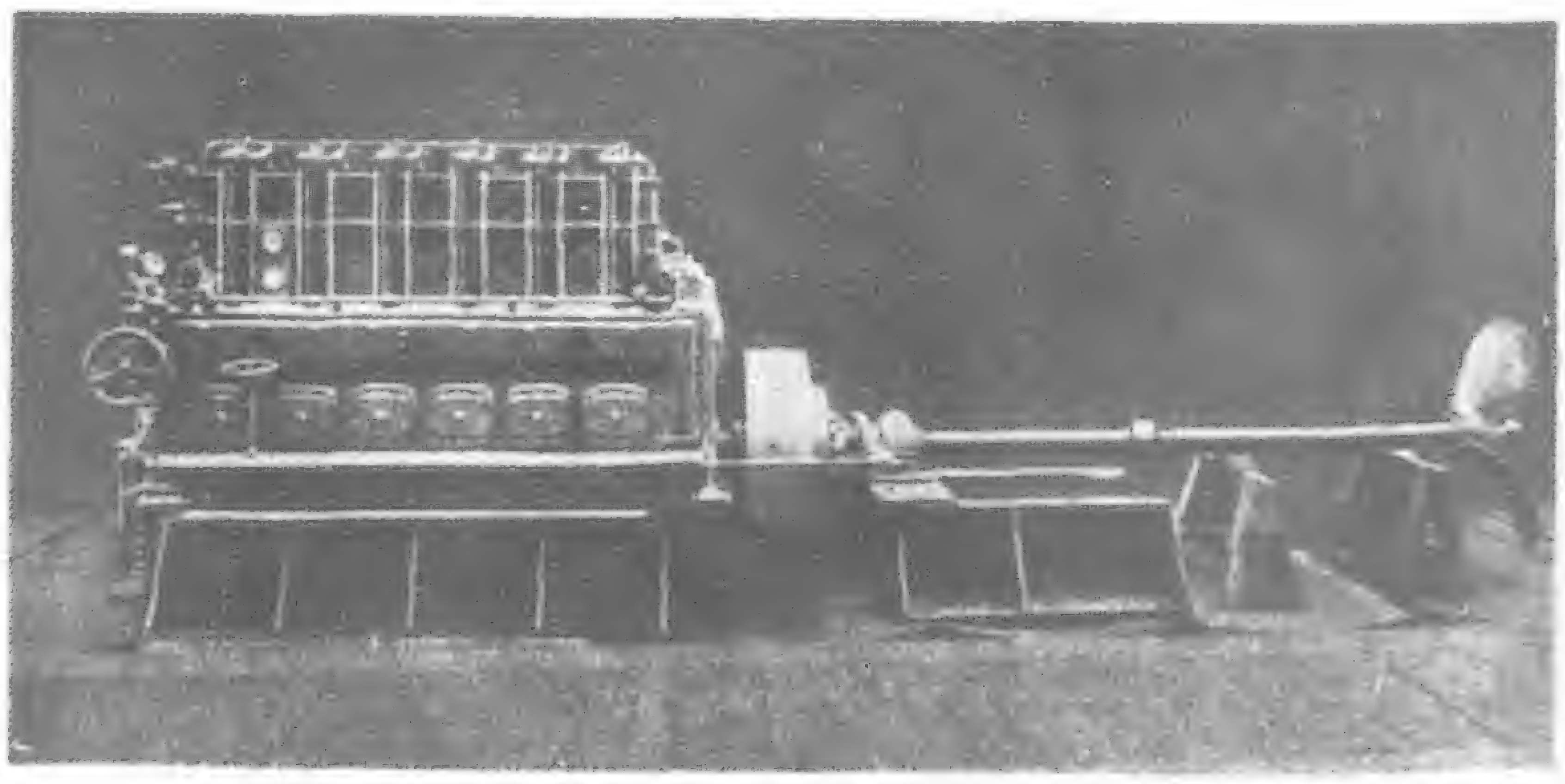


Fig. 4—Krupp reversible six-cylinder marine Diesel engine for fishing craft. The drag-net winch is driven from the engine pulley over a friction clutch

For this purpose, two plans have so far proved particularly well suited :—

(1) Operation by belt from a pulley connected to the engine by a friction clutch on the free end of the crankshaft extension, the net winch being engaged and disengaged by means of this friction clutch.

(2) Belt drive from a flywheel designed as a belt pulley, to a fast-and-loose pulley on the winch shaft. Operation of the winch is effected by shifting the belt from one pulley to the other. In order to prevent the belt from running when the net winch is not in use, a jockey pulley is provided on the net-winch pulley. By lifting the idler, the belt is disengaged so that it no longer bears on the flywheel and can therefore not be taken along by it.

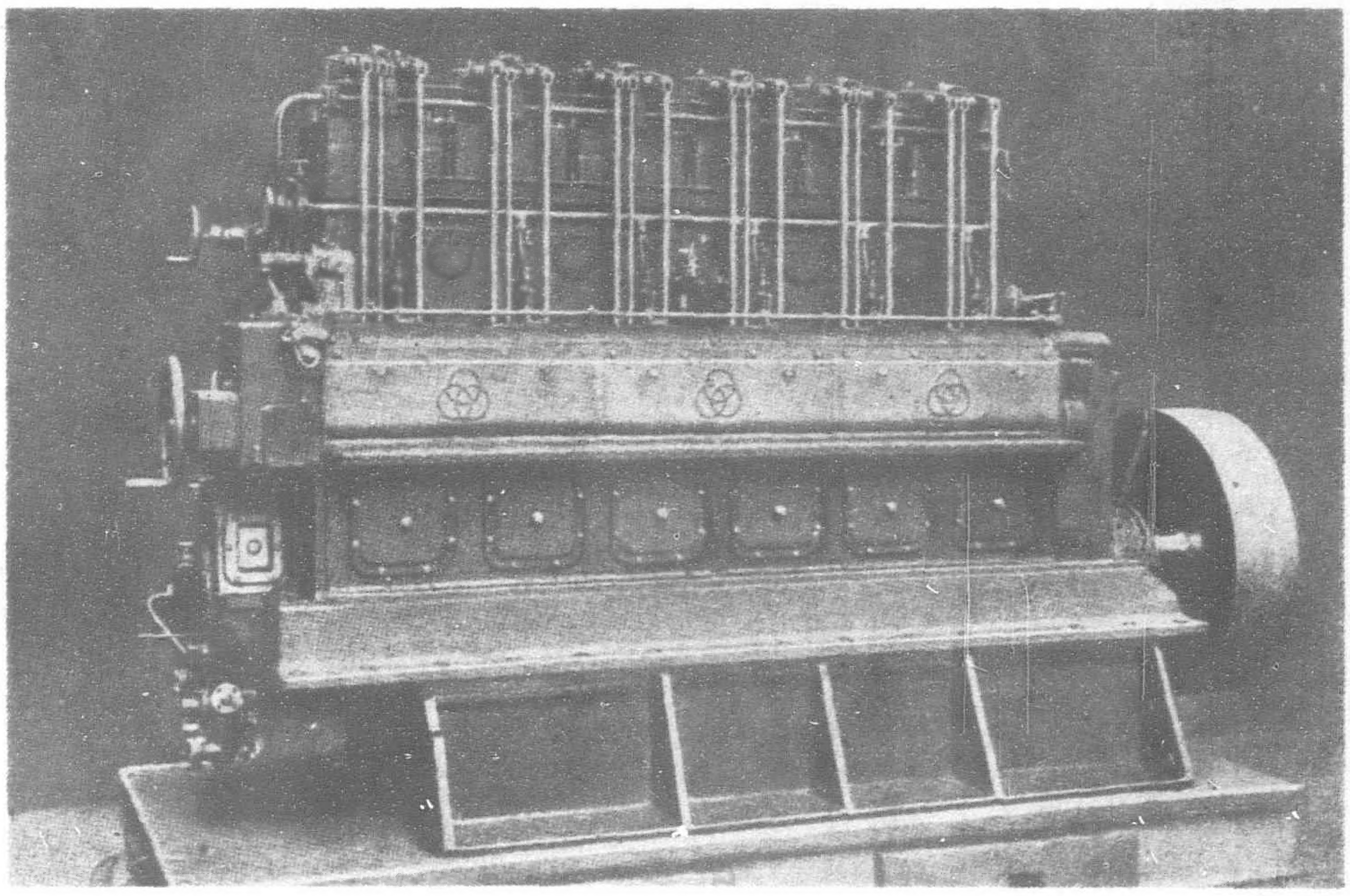


Fig. 5—Krupp reversible six-cylinder marine Diesel engine. Drag-net winch driven from an electric motor

A view of a net winch is shown in Fig. 2. The average speed of the winch is about 40 r.p.m. The speed reduction from the net-winch pulley to the winch is effected by way of a worm gear.

In order to allow the winch to be operated also when the ship is at rest, a friction clutch is arranged between the directly reversible engine and the propeller shaft for cutting the propeller off while the engine is running. Non-reversible engines can be disengaged from the propeller shaft by means of the reversing gear.

Figs. 3 to 5 show three Krupp four-cycle marine Diesels of varions sizes, of a type which has been installed in numerous fishing vessels. Fig. 3 illustrates a non-reversible four-cylinder engine with reversing gear. The net winch is in this case driven from the flywheel, which serves as a belt pulley. Fig. 4 presents a reversible six-cylinder engine. The belt-pulley friction clutch for operating the net winch is seated on the free shaft end seen at the front of the engine. The handwheel with vertical spindle actuates the friction clutch built into the flywheel for engaging and disengaging the propeller shaft. Fig. 5 shows a reversible six-cylinder engine of somewhat larger output. In this case, the net winch is driven, not from the main Diesel engine, but from an electric motor. All of the above-mentioned Diesel engines are particularly well suited to fishing-craft use as having the advantages of simplicity of design, ready accessibility to all vital parts, ease of attendance, dependability in service, and operating economy.

The solid injection employed in Krupp Diesel engines has rendered an excellent account of itself in many years of use in marine Diesel engines. It has also been tried out for the difficult task of fishing-vessel operation and has proved fundamentally reliable and economic. With this method of injection, the fuel is directly sprayed at high pressure from the fuel pump through the fuel-valve nozzle into the combustion chamber of the cylinder. This has the advantage that the engine can be started cold without the use of auxiliaries.

Fig. 6 is a cross-section through the cylinder of one of these engines. The crank case and cylinder are cast as an integral block, which is bolted together with the bed plate. The crank-case bearings have cast white-metal liners which can be easily removed without the need of taking out the crankshaft. The crank case is closed oiltight all over, so that no dirt and dust can get in and foul the lubricating-oil circulation.

The cylinder liners are held only at their upper ends between the cylinder and cylinder cover and are therefore free to expand downward. In order to secure an efficient lubrication of the cylinders even when the engine runs at low speed, which must be maintained during the setting of the drag-net, they are lubricated, not alone by the spraying oil but also by means of special pressure oilers.

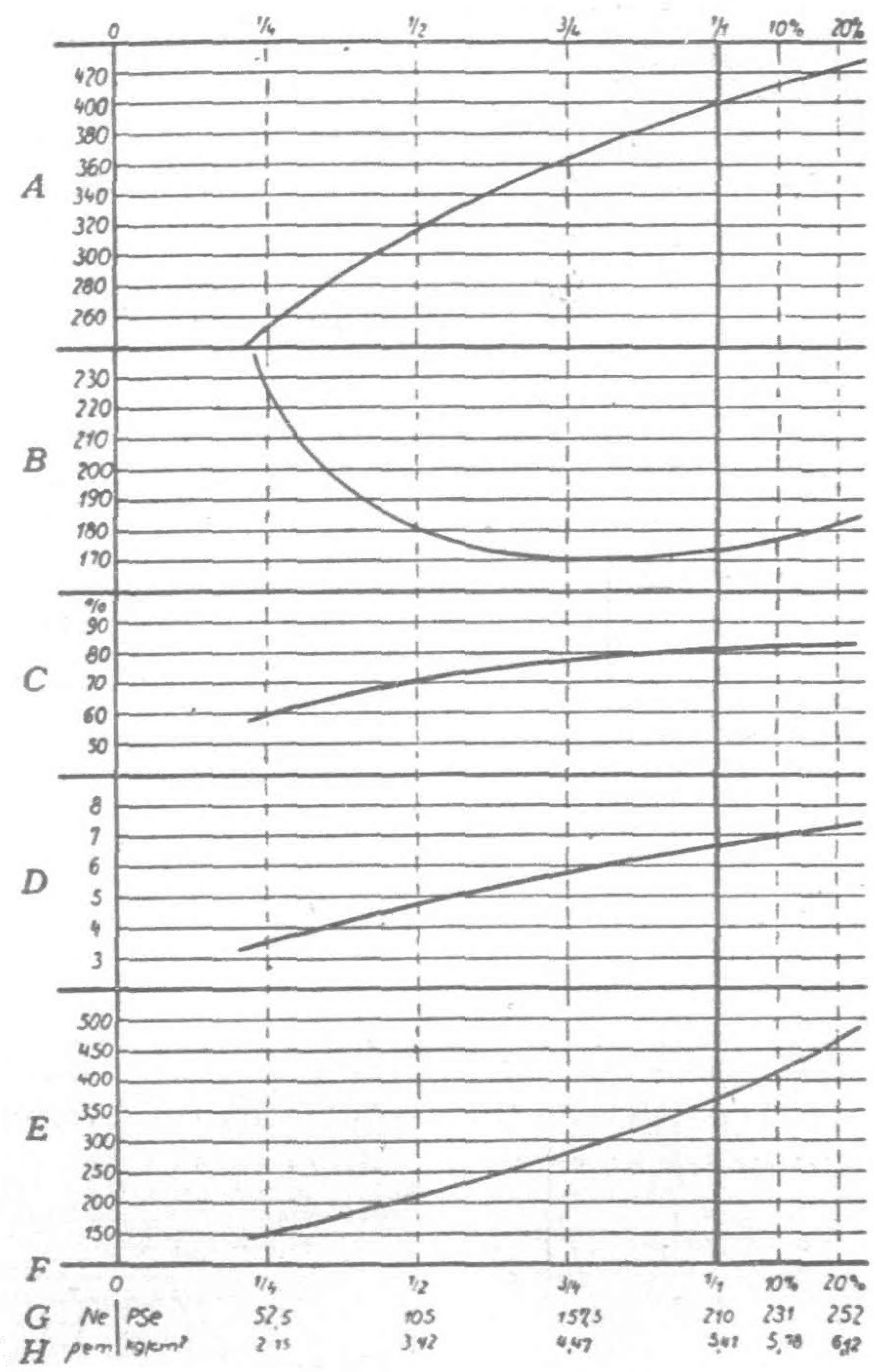


Fig. 9—Test-stand results of a Krupp four-cycle marine Diesel engine of 210 h.p. continuous output at 400 r.p.m.

A *Engine speed r.p.m.*
B *Specific fuel consumption, grm. per HPh (100 grm.-0.22 lb.)*
C *Mechanical efficiency per cent.*
D *Mean indicated piston pressure kg/cm.² (1 kg./cm²-14.2 lb. per sq. in.*
E *Exhaust temperature, deg. C.*
F *Load*
G *Output b.h.p.*
H *Mean effective piston pressure, kg./cm.²*

In the reversible engine, the camshaft has one "ahead" and "astern" lobe each for the intake, exhaust, and starting valves, and for the fuel pump. For reversing, the camshaft is axially shifted, thereby bringing the lobes for the opposite direction of rotation into position on the motion rods. For overhauling, the camshaft can be easily withdrawn sideways from the machine after removing a cover in the casing.

As mentioned already, the engines can be started cold without preparations or auxiliaries of any kind. The starting valve employed, which has been used by Krupp for many years, is cut in by compressed air and, like the intake and exhaust valves, is governed from the camshaft. This valve is dimensioned in such a way as to open in the starting position only when the pressure in the cylinder is lower than in the starting line. Backfiring of the fuel-air mixture or of sparks into the starting line is therefore rendered impossible and the explosion of oil deposits in the starting line excluded.

Reversal of the six-cylinder engine of Figs. 4 and 5 is rapidly and dependably effected by hand. In manœuvring, the reversing handwheel, the fuel lever, and the starting lever must be operated. Because of the interconnection of the starting and fuel levers with the reversing gear, these levers cannot be operated unless and until the reversing operation is completed.

The speed is regulated by a governor, which operates as a safety governor at the upper speeds and prevents running

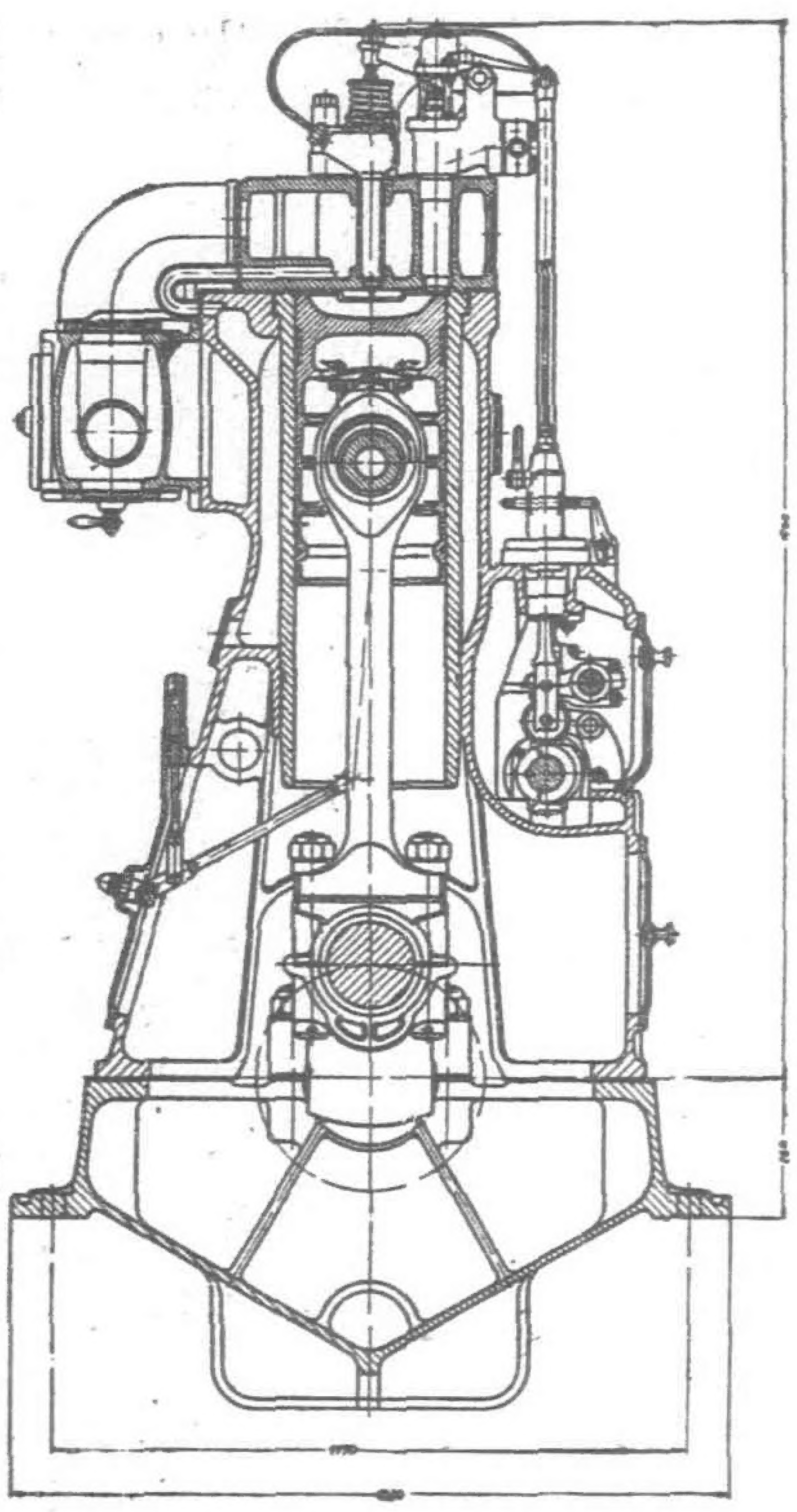


Fig. 6—Section through cylinder of marine Diesel engine

away of the engine. In order dependably to attain the low rate of revolution, of about one-fifth of the normal, which is needed when setting the drag-nets, the governor is equipped with a servomotor which easily overcomes the regulating forces at such low speeds. Retarded ignition at low speeds and advanced ignition at high speeds is obtained by adjusting automatically the beginning of the injection by small amounts, simultaneously with the fuel intake quantity.

All of the auxiliary units required for operating the engine are built on to and driven by the engine. The starting air compressor is arranged on the forward end and is disconnectable from the engine. The cooling-water and bilge pumps are also arranged in a readily accessible position laterally on the engine and are driven by a link from the camshaft. The two pumps are connected so that one can take the place of the other.

In the case of smaller vessels, it is generally demanded that the engine also drives an electric lighting plant. Larger marine plants are equipped with a special Diesel-dynamo compressor set, Fig. 7. Fig. 8 shows a longitudinal section through the engine room of a fishing vessel.

The results obtained in operation with a reversible six-cylinder engine of 210 h.p. rated output at 400 r.p.m., are shown in Fig. 9 The compression pressure in the cylinder is 31 kg./cm.² (440 lb. per sq. in.) and the maximum combustion pressure 46 kg./cm.² (650 lb. per sq. in.). At a cooling-water pressure of 0.6 atmos. (8.5 lb. per sq. in.) gauge, a mean entry temperature of 17° C. (62°F.) and an exit temperature of 37° C. (99° F.) were measured. Lubricant pressure was 1.4 atmos. (20 lb. per sq. in.) gauge. In the oil cooler, the lubricant was cooled down to 30° C. (86° F.).

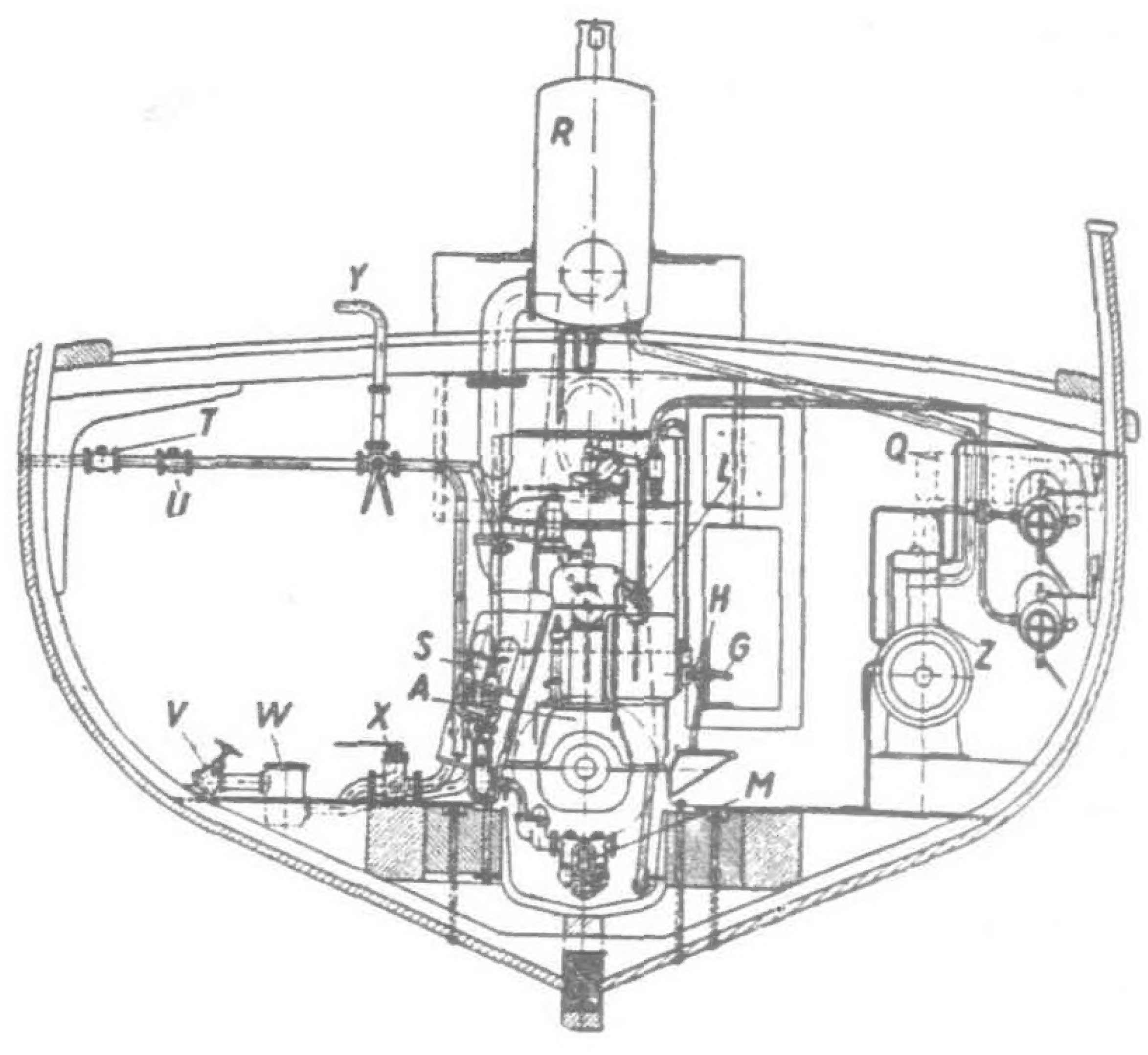


Fig. 7—Cross-section through engine room of Diesel-driven fishing vessel

With this Diesel engine, which, when operated during normal travel without drag-net, gave an output of 210 h.p. at 400 r.p.m., calculation showed an output of about 78 h.p. at 250 r.p.m. when running with drag-net. According to the propulsion curve, the driving output at the speed of 250 r.p.m. may, however, be assumed as being but 52 h.p., so that residual 26 h.p. must be charged to the effort required for dragging the net. Actually, a power consumption of 26 h.p. was measured when hauling in the drag-net, with the propeller disconnected.

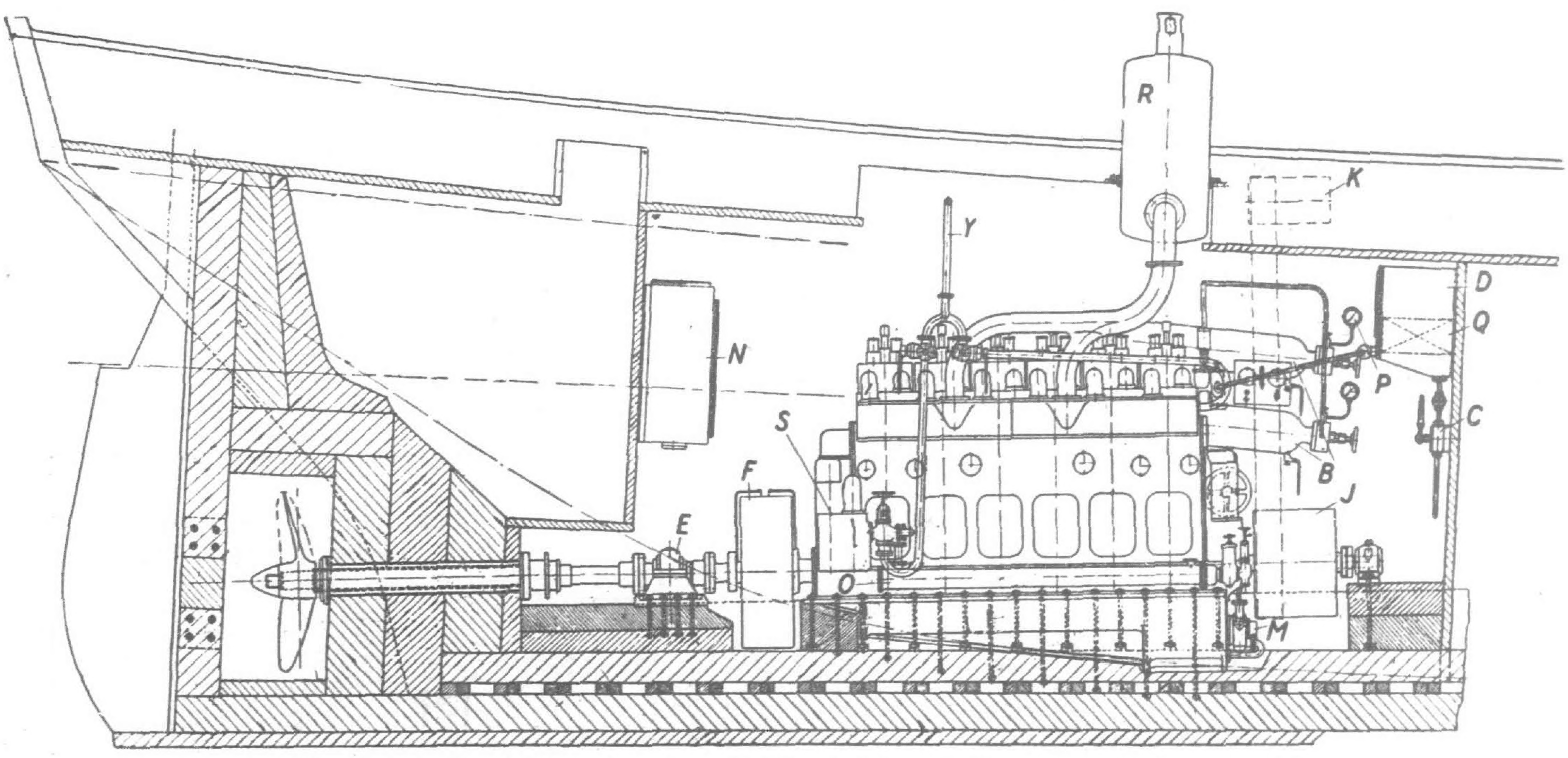


Fig. 8—Longitudinal section through Diesel-driven fishing vessel to Figs. 7 and 8

A Compressor
B Starting flask
C Hand pump for fuel
D Daily fuel tank
E Thrust bearing
F Flywheel and friction clutch
G Handwheel for propeller clutch
H Handwheel for reversing
I Pulley and friction clutch
K Net-winch pulley
L Hand pump for lubricating oil
M Gear pump for lubricating oil
N Lubricating-oil tank
O Oil cooler
P Pressure gauge
Q Storage battery
R Exhaust tank
S Cooling-water and bilge pump
T Check valve for cooling-water
U Check valve for bilge pump
V Seawater valve
W Filtering vessel
X Three-way cock
Y Pressure-water line
Z Diesel-dynamo-compressor set

Mammoth New Dock for Shanghai

Shanghai will be able to boast of one of the finest docks in the world when the new £500,000 wharf below Point Island, just outside the harbor area proper, is completed.

The project, which is being backed by the Government-owned Central Bank of China as a private enterprise, will provide an uninterrupted dock frontage of 2,500 feet.

The first section of the dock, expected to be completed in August next year, will consist of two 590-foot wharves, a small jetty for tenders and customs launches, an excellently designed customs building with baggage examination rooms, rest rooms, a cafe and other modern conveniences.

Engineering Notes

AVIATION

AIRCRAFT CARRIERS FOR JAPAN.—Simple ceremonies marked the laying of the keel of the aircraft carrier *Hiryu*, last naval vessel to be built under Washington Treaty limitations at the Navy Yard in Japan.

The new carrier, a sistership of the *Tenryu*, will displace 10,000 tons.

CANTON-HANOI LINE.—Preparations are reported to have been completed for the inauguration in the near future of the Canton-Hanoi air service. Fare for a single trip has been fixed at $150 and that for return trip at $270. Mail matter, it is understood, will be charged according to international postage rates.

AIR DEVELOPMENT IN MANCHOUKUO.—The headquarters of the Kwantung Army issued a communique recently stating that the air routes between Mukden, Tunghua, Harbin and Mutankiang, on the upper reaches of the Sungari, which have hitherto been reserved for military service, have been opened for general passenger service.

COMMUNICATIONS

HIGHWAYS IN FUKIEN.—All the projected highways in Southern Fukien have been completed, according to information from the Provincial Department of Reconstruction. Mr. Chen Ti-cheng, Provincial Commissioner of Reconstruction who is also Director of the Highway Bureau of the National Economic Council, will shortly conduct an inspection of the roads.

GREAT NEW BRIDGE.—The contract for building a great new bridge to span the Hoogly River at Howrah, a suburb of Calcutta, has been awarded to a British firm, the Cleveland Bridge and Engineering Company, Ltd., of Darlington. Other firms which offered tenders for the contract were Krupps and an Indian combine, Braithwaite, Burn and Jessop.

The award, which was announced recently, follows a controversy which has lasted several months.

Protests at the suggestion of giving it to a British firm were made in the Legislative Assembly.

The bridge, which will carry a road, tramlines and footpaths, will cost about £1,750,000. It will have a main span of 1,500 feet.

MINING

JAPAN CONSUMES MORE COPPER.—Japan now ranks as the fourth largest consumer of copper in the world ; her total is only exceeded by the United States, Germany and Great Britain.

Japan's consumption of copper in 1935 reached the record high figure of 134,170 metric tons. Of this total 65,300 metric tons were imported.

OIL EXPLORATION.—Two Japanese companies, including the Nippon Sekiyu Kaisha, have concluded an agreement for oil exploration work in Netherlands Borneo, to the north of the Tarakan oilfields of the Royal Dutch-Shell group. Two years ago exploration work in this area was started by these companies, but was abandoned later. There seems now to be proof of actual oil finds at great depths and the exploration will be resumed.

COAL IN SZECHUEN.—Rich deposits of coal have been discovered in Southern Szechuen. According to a report from Mr. Li Hsien-cheng, geologist of the Western Science Institute, one of the richest coal fields ever discovered in Szechuen has been found in Yungchuan. The mine area covers more than 667 square miles. Coal deposits have also been found by Mr. Shang Huang-chiao, Director of the Geological Section of the Science Institute, in Yunyuan and Huili.

JAPANESE CAMPHOR PRODUCTION.—The preliminary estimate of this year's camphor production in Formosa was about 2,700,000 kilogs. On the basis of actual output to the end of last September, the total has now been revised to 3,000,000 kilogs, as against an actual production of 2,400,000 kilogs in 1934. With the output in Japan proper estimated at 2,700,000 kilogs, the grand total of camphor production this year will be 5,730,000 kilogs, the largest ever recorded since the establishment of the Camphor Monopoly Office.

JAPANESE COAL INDUSTRY.—According to the *Journal* of the Fuel Society of Japan, the Japanese Coal Mine Owners' Association and the Showa Coal Sales Co., which now controls practically the whole of the coal trade in Japan, are about to take up the consideration of a number of questions with the object of further improving the trade. Among the problems to be dealt with are the rationalization of coal transport by the joint chartering of ships ; rationalization of the use of loading equipment and the unification of specifications as to kinds and qualities of coal.

INDUSTRY

" RUBBER " YARN.—It is reliably reported that the Mitsui interests will shortly organize a company to manufacture " rubber " yarn, recently invented by the company's engineering staff. The new company will specialize in the exportation of the product to the United States and Europe.

JAPANESE DOCKYARDS EXPANDED.—Acting with the understanding of the naval authorities, the directors of the Uraga Dockyards, Yokohama, to-day decided to treble the firm's present capital to Y.14,000,000, to permit expansion of the docks and erection of a plant for the manufacture of aeroplane parts.

JAPANESE MILLS IN TIENTSIN.—By the end of this year, Japan will control spinning mills in the Tientsin area with about 300,000 spindles, not counting the 490,000 spindles in Japanese mills at Tsingtao.

Cloth and yarn turned out by these plants will be more than enough to supply all the needs of North China and the surplus will have to be sold in Central and South China.

COAL LIQUEFACTION.—Bringing the total number of coal hydrogenation plants, projected by Japanese firms to three, the Chosen Nitrogen Co., has filed an order with the Kobe Iron Works for processing machinery capable of extracting 50,000 tons of gasoline from coal each year. Scheduled to begin operations at Konan, Korea, in April next year, the plant, together with those planned by the South Manchuria Railway Co., and the Mitsui interests, will assure Japan a supply of 100,000 tons of gasoline each year, experts say. The so-called Navy process of low-temperature liquefaction will be used by the Chosen organization, which will cost Y.15,000,000 to build. This system utilizes about four tons of coal to obtain one of gasoline.

CHINESE COTTON MILLS.—The Shanghai Chinese Cotton Mill Owners' Association reports that there are altogether 95 Chinese mills, operating 2,807,391 spindles, 144,045 doubling spindles and 22,567 looms, while 136,724 spindles, 8,600 doubling spindles and 3,029 looms are intended to be added to the existing numbers.

COTTON IN SIAM.—As an initial step in the Nippon-Siamese plan for economic co-operation, the Bangkok Government has engaged the services of Dr. Shinzo Mihara, who will act as special adviser to promote the raising of raw cotton. The present output of 100,000 bales will be brought to 1,000,000 bales under Dr. Mihara's plans and guidance.

MONGOLIAN WOOD.—Taking advantage of the restricted imports of Australian wool into Japan, the Great Mongolia Company, formed last October by the Okura interests, will shortly begin purchases of Mongolian wool for shipment to Japan.

The Company, which has a capitalization of Y.500,0(0, has been very active in Inner Mongolia since the inauguration of the Chihfeng-Yenpeishow railway, opening up markets for Japan-made goods.

The main office of the Great Mongolia Company is located in Hsinking, with branches in Chihfeng, Dolonnor and Kalgan.—*Domei.*

RAILWAYS

BIG RAILWAY LOAN.—It is reported that the Ministry of Railways has succeeded, in obtaining a loan of \$3,000,000 from the China Farmers' Bank in Shanghai for building the Szechuen-Hunan and Szechuen-Kweichow Railways. Bonds amounting to \$4,000,000 were put up as securities. The loan money will be returned in one year with interest of eight per cent. The head office of the bank in Hankow has already approved of the arrangement.

NEW RAILWAY COACHES.—Thirteen third-class passenger coaches, ordered by the administration of the Peiping-Mukden Railway from Japanese plants through the South Manchuria Railway Company, are nearing completion.

SOOCHOW-KASHING LINE.—Satisfactory trial runs on the newly completed railway line between Soochow, on the Nanking-Shanghai Railway, and Kashing, on the Shanghai-Hangchow-Ningpo Railway, were made recently. Regular train service will be inaugurated in the next fortnight. The new line, which took 18 months to build, is 76 kilometers long.

RAILWAY EXTENSION.—More than \$6,000,000 will be required for the construction of the extension line of the Kiao-Tsi Railway, from Tsinan to Liuchen on the Shantung-Honan border. A special committee has been formed by the Ministry of Railways and the Shantung provincial government to take charge of the construction work. Half the funds will be provided by the Shantung authorities while the balance will be raised by banks in Shanghai through the Ministry of Railways. The new line, when complete, is expected to benefit both provinces financially.

NEW RAILWAYS IN MANCHOUKUO.—Three new railways have been added to the vast web of railways covering the new Empire of Manchoukuo.

The lines are: the Mutarkiang-Linkow Railway, 110 kilometers; the Linkow-Mishan Railway, and the Solun-South Hsingan Railway, 130.8 kilometers.

While the first of these two lines nearly parallel Manchoukuo's eastern border with Soviet Russia, the third forms a spearhead pointing at the border with Outer Mongolia.

The lines were completed six months ago, and have since been tested by the South Manchuria Railway Company, which will now operate them for the Manchoukuo Ministry of Communications.